Diploma

in

Business Administration

Study Manual

Managerial Accounting

The Association of Business Executives

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ABE Diploma in Business Administration

Study Manual

Managerial Accounting

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Diploma in Business Administration – Part 2

Managerial Accounting

Syllabus

Aims

1. Understand the costing methods and techniques available.
2. Select appropriate methods and techniques which an organisation can use to calculate costs under different situations.
3. Construct budgets for both planning and control purposes, including cash flow forecasts.
4. Understand all aspects of working capital management.
5. Appreciate how information technology can assist when preparing information for management.
6. Understand capital investment appraisal and financial mathematics

Programme Content and Learning Objectives

After completing the programme, the student should be able to:

1. Understand the control systems required for materials, labour and overheads

- the nature of costs
- recognise the differences between fixed, variable, semi fixed and semi variable costs
- problems of allocation/apportionment of overheads
- pricing of materials
- calculation of overhead recovery rates

2. Analyse data according to various cost classifications and the effect of volume on costs

- cost volume profit analysis
- comparison between the economists and accountants cost volume chart

3. Recognise how cost systems differ by activity – i.e. job and process costing

- characteristics of process costing, equivalent units, methods of pricing, normal and abnormal waste, joint and by products
- methods of apportionment of joint costs

4. Use costs for short term decision-making

- marginal costing, key factors, opportunity costs, sunk costs, differential costs, qualitative aspects

5. Appreciate the difference between marginal and absorption costing

- format of a marginal profit statement, format of an absorption profit statement

6. Recognise the purpose of budgetary control

- construct budgets for both planning and control purposes
- administration of budgets, roll over budgets, objectives of budgets, the budget key factor, functional budgets, master budgets, behavioural aspects of budgetary control
- zero based budgets

7. Explain the purpose of standard costing

- calculate and analyse variances for materials, labour
- overheads and sales, types of standards, preparation of operating statements

8. Explain the purpose of working capital management

- operating cycle, funding and control of working capital

9. Understand the uses of information technology when presenting management with information

10. Capital investment appraisal and financial mathematics

- financial and non-financial factors to be considered when making investment decisions
- methods of investment appraisal, including payback, the time value of money and average rate of return
- the calculation of compound interest
- discounted cash flow
- net present value
- internal rate of return

Method of Assessment

By written examination. The pass mark is 40%. Time allowed 3 hours.

The question paper will contain:

Six questions of which four must be answered.

Five questions will be computational with written parts in the majority of these questions and one will be an essay question.

All questions carry equal marks.

Reading List

Essential Reading

- Drury, C. (1995), *Costing: An Introduction*, 3rd Edition; Thomson Business Press

Additional Reading

- Drury, C. (2000), *Management and Cost Accounting*, 5th Edition; Thomson Business Press

Journals

- Management Accounting (CIMA)

Study Unit 1

Management Accounting and Information

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INTRODUCTION

We begin our study of this module with some definitions which will make clear what managerial or management accounting is, what it involves and what its objectives are.

A number of factors must be considered when setting up a management accounting system and the management style and structure of an organisation will affect the system which it creates.

Information is an important part of any such system and the study unit will go on to examine its various types and sources.

A. MANAGEMENT ACCOUNTING

Some Introductory Definitions

The Chartered Institute of Management Accountants (CIMA) in its Official Terminology describes accounts as follows:

- The classification and recording of actual transactions in monetary terms, and
- The presentation and interpretation of these transactions in order to assess performance over a period and the financial position at a given date.

The American Accounting Association (AAA) supplies a slightly more succinct definition of accounting:

> *"....the process of identifying, measuring and communicating economic information to permit informed judgements and decisions by users of information."*

Another way of saying this is that accounting provides information for managers to help them make good decisions.

Cost accounting is referred to in the CIMA Terminology as:

> *"That part of management accounting which establishes budgets and standard costs and actual costs of operations, processes, departments or products and the analysis of variances, profitability or social use of funds. The use of the term* ***costing*** *is not recommended."*

Management accounting is defined as:

> *"The provision of information required by management for such purposes as:*
>
> *(1) formulation of policies;*
>
> *(2) planning and controlling the activities of the enterprise;*
>
> *(3) decision taking on alternative courses of action;*
>
> *(4) disclosure to those external to the entity (shareholders and others);*
>
> *(5) disclosure to employees;*
>
> *(6) safeguarding assets.*
>
> *The above involves participation in management to ensure that there is effective:*
>
> *(a) formulation of* ***plans to meet objectives*** *(long-term planning);*

(b) *formulation of **short-term operation plans** (budgeting/profit planning);*

(c) *recording of **actual transactions** (financial accounting and cost accounting);*

(d) *corrective action to bring **future actual transactions** into line (financial control);*

(e) *obtaining and controlling **finance** (treasurership);*

(f) *reviewing and reporting on **systems and operations** (internal audit, management audit)."*

Financial accounting is referred to as:

> *"That part of accounting which covers the classification and recording of actual transactions of an entity in monetary terms in accordance with established concepts, principles, accounting standards and legal requirements and presents as accurate a view as possible of the effect of those transactions over a period of time and at the end of that time."*

All three branches of accounting should be integrated into the company's reporting system.

- **Financial accounting** maintains a record of each transaction and helps control the company's assets and liabilities such as plant, equipment, stock, debtors and creditors. It satisfies the legal and taxation requirements and also provides a direct input into the costing systems.
- **Cost accounting** analyses the financial data into more detail and provides a lot of the information used for control. It also provides key data such as stock valuations and cost of sales which are fed back into the financial accounting system so that accounts can be finalised.
- **Management accounting** draws from the financial and cost accounting systems. It uses all available information in order to advise management on matters such as cost control, pricing, investment decisions and planning.

Objectives of Management Accounting

(a) **Planning**: all organisations should plan ahead in order that they can set objectives and decide how they should meet them. Planning can be short- or long-term and it is the role of the management accounting system to provide the information for what to sell, where and at what price. Management accounting is also central to the budgetary process which we shall look at in more detail later.

(b) **Control**: production of the company's internal accounts, its management accounts, enables the firm to concentrate on achieving its objectives by identifying which areas are performing and which are not. The use of management by exception reports enables control to be exercised where it is most useful.

(c) **Organisation**: there is a direct relationship between the organisational structure and the management accounting system. It is often difficult to determine which has the greater effect on the other, but it is necessary that the management accounting system should produce the right information at the right cost at the right time, and the organisational structure should be such that immediate use is made of it.

(d) **Communication**: the existence of a budgetary and management accounting system is an important part of the communication process; plans are outlined to managers so that they are fully aware of what is required of them and the management accounts tell them whether or not the desired results are being achieved.

(e) **Motivation**: more will be said about the motivational aspects of budgeting later, but suffice to say here that the targets included in any system should be set at such a level that managers and the people who work for them are motivated to achieve them.

Setting Up a Management Accounting System

There are several factors which should be borne in mind when a system is being set up:

- What information is required?
- Who requires it?
- How often is it required?

Further thought will need to be given to such matters as:

- What data is required to produce the information?
- What are the sources of this data?
- How should it be converted?
- How often should it be converted?

Finally, factors such as organisational structure, management style, cost and accuracy (and the trade-off between them) should also be taken into account.

The Effect of Management Style and Structure

Theories of management style range from the autocratic at one end of the spectrum to the democratic at the other. Which style a particular organisation uses very much affects the management accounts system. With a democratic style for instance, it is likely that decision making is devolved further down the management structure and information provided will need to reflect this. An autocratic style, by contrast, means that decision making is exercised at a higher level and therefore the necessary information to enable the function to be carried out will similarly be provided at this level also.

In addition, the management structure will also have an impact, a flat management structure will mean that a particular manager will need to be provided with a greater range of reports (e.g. on sales, marketing, production matters, etc.) than in a company with a functional structure where reports are only required by a manager for his or her own function, such as sales.

Note that management structure is much more formalised than management style; it is possible for instance to have both democratic and autocratic managers within a particular management structure.

B. INFORMATION

Information and Data

Information can be distinguished from data in that the latter can be looked upon as facts and figures which do not add to the ability to solve a problem or make a decision, whilst the former adds to knowledge. If, for instance, a memo appears on a manager's desk with the figure "10,000" written on it, this is most certainly data but it is hardly information.

Information has to be more specific. If the memo had said "sales increased this month by 10,000 units" then this is information as it adds to the manager's knowledge. The way in which data or information is provided is also affected by the Management Information System (MIS) which is in use. Taking our example in a slightly different context, the figure of 10,000 may be input to the system as an item of data which, at some stage, will be converted and detailed in a report giving the information that sales have increased by 10,000 units.

Users of Information

The Corporate Report of 1975 set out to identify the objectives of financial statements and identified the user groups which it considered were legitimate users of them. The following list is important in that once we define whom a report is for, it can be tailored specifically to their needs.

Users of information and the uses to which that information can be applied are as follows:

- Managers – to help in decision making.
- Shareholders and investors – to analyse the past and potential performance of an enterprise and to assess the likely return on investments.
- Employees – to assess the likely wage rate and the possibility of redundancy and to look at promotion prospects.
- Creditors – to assess whether the enterprise can meet its obligations.
- Government – the Office for National Statistics collects a range of accounting information to help government in its formulation of policy.
- Inland Revenue – to assess taxation.

Non-profit-making (or not-for-profit) organisations also need accounting information. For example, a squash club has to establish its costs in order to fix its subscription level. A local authority needs accounting information in order to make decisions about future expenditure and to fix the level of contribution by local residents via the Council Tax. Churches need to keep records of accounting information to satisfy the local diocese and to show parishioners how the church's money has been spent.

Characteristics of Useful Information

There are certain characteristics which relate to information:

(a) Purpose – if information does not have a purpose then it is useless and there is no point in it being produced. To be useful for its purpose it should enable the recipient to do his or her job adequately. The ability of information to achieve its purpose depends on the following:

- The level of confidence that the recipient has in the information.
- The clarity of the information.
- Completeness.
- How accurate it is.
- How clear it is to the user.

(b) The recipients of the information must be clearly identified; for information to be useful it is necessary to know who needs it.

(c) Timeliness – information must be communicated when it is required. A monthly report which details a problem must be produced as quickly as possible in order that corrective action can be taken. If it takes a month to produce then this may be too long a time-scale for it to be useful.

(d) Channel of communication – information should be transmitted through the appropriate channel; this could be in the form of a written report, graphs, informal decisions, etc.

(e) Cost – as data and information cost money to produce, it is necessary that their value outweighs their costs.

To summarise, having looked at the general qualities of information, the characteristics of good information are:

- It should be relevant for its purpose.
- It should be complete for its purpose.
- It should be sufficiently accurate for its purpose.
- It should be understandable to the user.
- The user should have confidence in it.
- The volume should not be excessive.
- It should be timely.
- It should be communicated through the appropriate channels of communication.
- It should be provided at a cost which is less than its value.

C. COLLECTION AND MEASUREMENT OF INFORMATION

Sources of Information

The information used in decision making is usually data at source and has to be processed to become information. The main sources of information can be categorised as internal or external.

(a) **Internal**

The main sources and types of internal information, and the systems from which such information derives, are summarised in the following table.

Source	System	Information
Sales invoices	Sales ledger	Total sales Debtor levels Aged debtors Sales analysis by category
Purchase orders/Invoices	Purchase ledger	Creditor levels Aged creditors Total purchases by category
Wage slips	Wages and salaries	Total wages and salaries Salaries by individual/department Employee analysis (i.e. total number, number by department)

(b) **External**

There is a wealth of information available outside of the organisation and the following table provides just a few examples:

Source	**Information**
Market research	Customer analysis, competitor analysis, product information, market information.
Business statistics	Exchange rates, interest rates, productivity statistics, social statistics (i.e. population projections, family expenditure surveys, etc.), price indices, wage levels and labour statistics.
Government	Legislation covering all aspects of corporate governance such as insider dealing, health and safety requirements, etc.
Specialist publications	Economic data, foreign market information.

Some of the above overlap and there are certainly many more sources of information that you may be able to think of, both internal and external. The uses that the information can be put to are greater than the sources and will depend on whom the information is for. The sales department, for instance, may wish to have details of a customer in order to market a new product to them, whilst the credit control department may wish to have information which may lead them to decide that no more credit should be given to the customer.

Again, a few moments' reflection should provide you with many more examples of the uses to which information can be put and the potential conflicts that can arise.

Relevancy

For information to be useful it has to be relevant and an accounting system is designed to be a filter similar to the brain, providing only relevant information to management. Obviously the system must be designed to comply with the wishes or needs of management.

Consider a manager who has to decide on a course of action in a situation where he plans to purchase a machine, and has an operating team which can perform two distinct functions with the machine. It would be irrelevant for him to consider the cost of the machine in his decision-making process as, irrespective of which course of action he decides upon the cost of the machine remains the same.

Relevance is thus at the heart of any accounting or management information system. The accountant must be familiar with the needs of the enterprise, since if information has no relevance it has no value.

The inclusion of non-relevant data should be avoided wherever possible, since its inclusion may increase the complexity of the decision-making process and potentially lead to the wrong decision being taken.

Measuring Information

Accountants are used to expressing information in the form of **quantified data**. Accountants are not unique in this approach; in the world of sport we record the performance of an athlete in the time he takes to run a certain distance, or how far he throws the javelin, or how high he jumps. Even in gymnastics the performance of the gymnast is reduced to numbers by the judges.

Not all decisions can be reduced to numbers and although accounting information is usually expressed in **monetary terms**, a management accountant must be prepared to provide accounting information in non-monetary terms.

If management decides that it wishes to adopt a policy to improve employee morale and to foster employee loyalty in order to achieve a lower labour turnover rate, the benefit in lower training costs may be expressed in monetary terms, but the morale and loyalty cannot be directly measured in such terms. Other **quantitative** and **qualitative** measures will be needed to evaluate alternative courses of action.

In order to measure information the unit of measurement should remain stable, but this is not always possible. Inflation and deflation affect the value of a monetary measure and we shall discuss how we can allow for such changes when we consider ratios in a later study unit.

Finally, when considering measurement within an information system we must always be aware of the **cost** of such a system. The value of measuring information must be greater than the costs involved in setting-up the system.

Figure 1.1 illustrates the point that above a certain level of information the cost of providing it rises out of all proportion to the value.

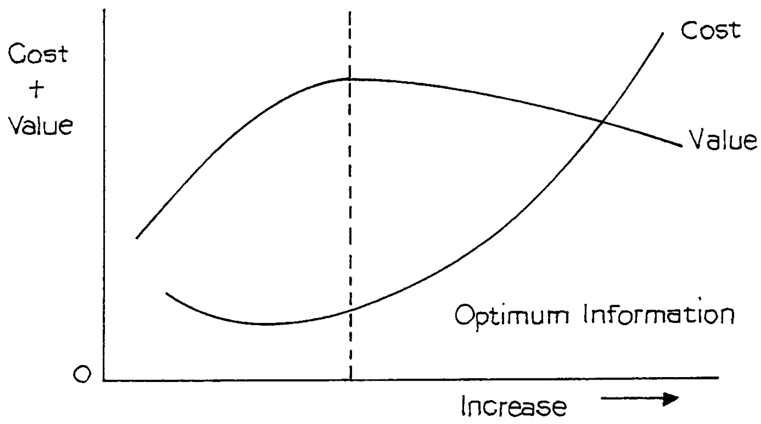

Figure 1.1

Communicating Information

A communication system must have the following elements:

- transmitting device
- communication channel
- receiving device.

These elements are required in order to communicate information from its source to the person who will take action on this information. We can illustrate the process diagrammatically as follows:

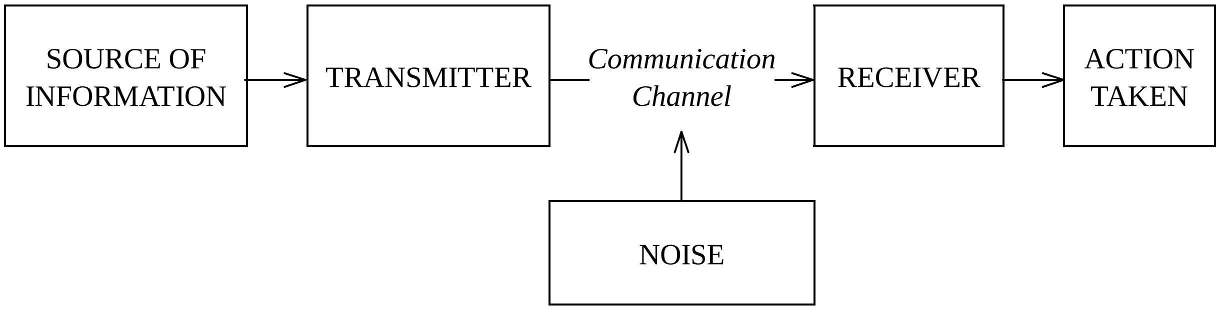

Figure 1.2

So let us look at the various elements in the communication system as they apply to an accounting or management information system. We have already considered the **sources of information**.

The accountant is the **transmitter** and he or she prepares an accounting statement to cover the economic event. The accounting statement is the **communication channel** and the manager is the **receiver**. The manager then interprets or decodes the accounting statement and either directly or through a subordinate **action is taken.**

In a perfect system this should ensure that accountancy information has a significant influence on the actions of management. However, noise can, by its nature, render a system imperfect.

Noise is the term used for interference which causes the message to become distorted. In accounting terms this can be the transposition of figures or the loss of a digit in transmission. The minimisation of noise in an accounting system can be achieved by building in self-checking devices and other checks for errors.

Noise can also result from **information overload**, where the quantity of information is so great that important items of information are overlooked or misinterpreted. Remember the importance of **relevance**: too much irrelevant information will lead to information overload and the failure of the receiver to identify essential information.

We must also consider the human factor in information. We shall mention this in a later study unit, but for now it is important for you to note that the human factor can affect how managers use or fail to use accounting information.

Value of Information

Any accounting system should operate in such a way that it provides the right information to the right people in the right quantity at the right time.

We have already discussed the cost of providing information and the fact that the value of the information should exceed the cost of providing it.

Consider the situation where a company is offered an order to the value of £500,000. The customer would not be adversely affected if the company declined the order so there is no knock-on effect whether the order is accepted or rejected. The cost of producing the order is estimated to be either £375,000 or £525,000.

The weighted average cost of production is thus:

$$\frac{£375{,}000 + £525{,}000}{2} = £450{,}000$$

giving an expected profit of £50,000.

If we assume that there is a 50% chance that costs will be £375,000, leading to a profit of £125,000, and a 50% chance that costs will be £525,000 in which case the order would be rejected and no profit and no loss would be made, the expected value of possible outcomes is:

$$\frac{£125{,}000 + 0}{2} = £62{,}500$$

In order to make a decision it would be necessary to obtain further information. Using the above two profit figures of £50,000 and £62,500 we can establish that the gross value of information is £12,500 (£62,500 – £50,000). The company could thus spend up to £12,500 on obtaining additional information. If the information needed only cost £10,000 then the net value of information would be £2,500.

In this example we have assumed that the information that could be obtained was perfect information. Information that is less than perfect (this applies to most information!) is called imperfect information. To be perfect information in this case, the information would have to be such that the cost of production would be known with certainty.

Quantitative and Qualitative Information

Quantitative information can be most simply described as being numerically based, whereas qualitative information is more likely to be based on subjective judgements. Thus if the manager concerned with a particular project is told that the potential cost of a contract will be either £375,000 or £500,000, then this is quantitative information. As we have seen, it is usually necessary to obtain further information before a proper decision can be made and this may take the form of qualitative data which will vary according to circumstances. Thus, the ability of a supplier to meet deadlines and provide materials of a sufficient quality is all qualitative information.

Accuracy of Information

The level of accuracy inherent in reported information determines the level of confidence placed in that information by the recipient of it; the more accurate it is the more it will be trusted.

Accuracy is one of the key features of useful information, for without it incorrect decisions could easily be made. Returning to our earlier example, if the potential costs of the project under consideration are assessed at either £275,000 or £375,000, then the average cost would be £325,000 and the expected profit (£500,000 – £325,000) £175,000. Thus as both extremes produce a profit, it is unlikely that additional information would be requested which would have shown that the costs were inaccurate.

There is often, however, a trade-off between getting information 100% correct and receiving it in time for a decision to be made. In this instance it is usual for an element of accuracy to be sacrificed in the interests of speed.

The concept of accuracy and related areas such as volume changes and how uncertainty in relation to accuracy is overcome will be discussed in more detail when we consider budgeting and variable analysis.

Financial and Non-Financial Information

The most usual way for reporting to be undertaken is through the use of financial information in terms of turnover, profit, ratio analysis, etc. Another way of defining this would be to say that performance is cost based and the department being assessed is therefore a cost centre (which will be more fully defined later). In certain circumstances, however, i.e. where costs cannot be allocated to a department, then non-financial performance measures must be considered instead. Non-financial indicators will be described in detail in a later study unit, but for now one or two examples should help. For a maintenance department, these indicators might include:

(a) production time, i.e. $\frac{\text{Actual service time}}{\text{Total time available}}$; or

(b) ratio of planned to emergency (or unplanned) services in terms of time.

D. INFORMATION FOR STRATEGIC, OPERATIONAL AND MANAGEMENT CONTROL

Elements of Control

A large proportion of the information produced for and used by management is control information. By having this information, managers will be aware of what is happening within the organisation and its environment, and be able to use that information in making future plans and decisions. Control information provides the means of identifying past mistakes and preventing their reoccurrence.

The diagrammatic representation of this is as follows:

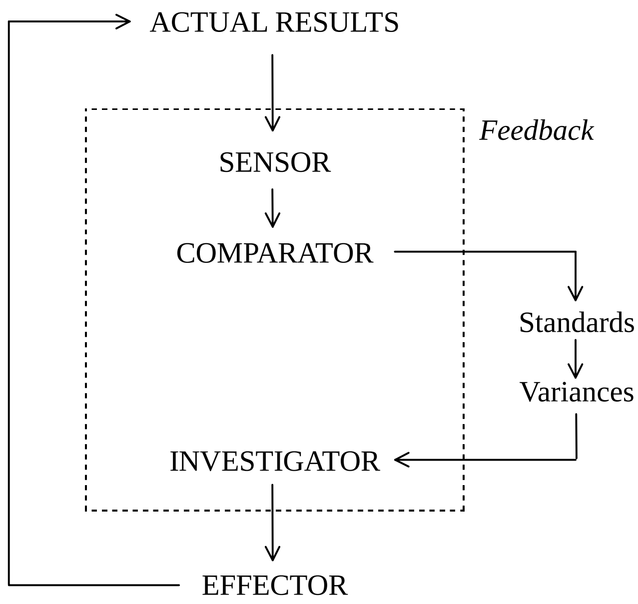

Figure 1.3: Single Loop Control System

The operation of the model is as follows:

(a) Results are measured via the sensor.

(b) These are compared with the original objectives or standards by the comparator.

(c) The process by which the information is collected and compared is known as feedback and this will be looked at in more detail shortly.

(d) Corrective action is identified using variance analysis.

(e) The corrective action is implemented via the effector.

As an example, suppose the planning department of a local authority has a target of producing a particular planning report within three weeks from the date of the request. The fact that it takes on average perhaps four weeks to produce such a report may be picked up by the internal audit department or through the provision of standard control information detailing such items as the length and content of the report. Whichever it is, this will be the sensor and the process of receiving the information is the feedback.

The comparator compares the actual length of time taken to produce the report against the required or expected time; in this instance four weeks as opposed to three. The operation of the comparator could be carried out either internally or external to the department concerned. In the latter instance the task could again fall to the internal audit department (assuming one exists of course).

The process of variance analysis would investigate the reasons why the time-scales are not being met. At the basic level this will be either that the standards are set at such a level that they cannot be met, or the standards are reasonable and it is the methods of achieving them that are inefficient.

Assume for the purposes of our current example that it is impossible, due to other circumstances, to achieve a time-scale of three weeks. In this case it is likely that the standard would be altered to four weeks.

The next time a planning report is produced, the process would be entered into and if the revised time-scale was not being met, the reasons why would be investigated and appropriate action taken.

Feedback

Feedback may be described as being positive or negative. When a system is using a measured scale it is travelling in any one of three directions at any time, i.e. it is travelling either:

(a) straight ahead; or

(b) in an upwards direction; or

(c) in a downwards direction.

Positive feedback is the term used when the corrective action needed is to move the system in the direction it is already travelling in, e.g. when a favourable sales volume variance occurs it means actual sales volume is higher than that budgeted. One course of action to exploit this favourable variance is to increase production so that increased sales can be taken advantage of.

Negative feedback is the term used when the corrective action needed is to move the system in the opposite direction to that in which it is travelling. For example, when the maximum level of stock for a particular item is exceeded, the corrective action is to reduce the stock level for that item by reducing production and/or increasing sales.

Control Information

The dividing line between control and decision making is a narrow one; in essence control is part of the decision-making process which we shall look at in more detail shortly.

Control information systems are part of an organisation’s structure; the structure of most organisations is a pyramid or hierarchy and therefore the control system operates in the same form. The diagram of this is as follows:

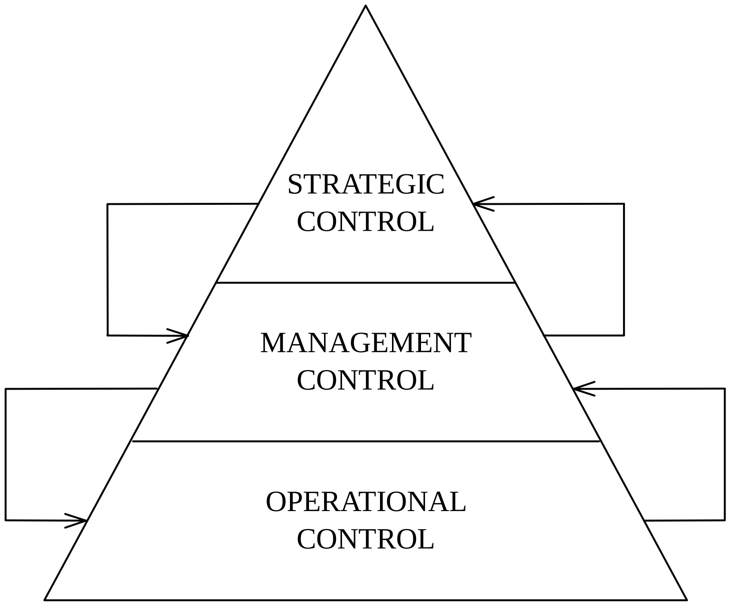

Figure 1.4: Flow of Control Information

The information flows are:

- between the levels, and
- within the same level.

Control information can be classified as follows:

(a) Strategic Control Information

This will be about the whole organisation and its environment. The main source of this information will be from the organisation's objectives, plans and budgets. It would also include information on items such as interest and exchange rates, population trends, economic trends and so on.

(b) Management Control Information

The information in this category will be about each division or department within the organisation. It will specifically depend upon the way the organisation is structured and the type of organisation it is. For instance, in an organisation structured by function, information will be about each function such as manpower (personnel), sales (marketing), production and finance for each division.

(c) Operating Control Information

This will be much more detailed and specialised than the previous two categories. It usually relates to each operating department within the organisation, e.g. stock control, credit control, etc.

To illustrate the differences a little more clearly, operating information could be the sales value for a particular product, management control information the total sales value for the division concerned and finally the total sales for the company an input to the strategic planning process.

Large organisations are frequently split into these smaller divisional units. In such organisations it is essential that the top level of the organisation's control system covers every division, as it is only through the control system that top management can know what is happening in the whole organisation.

E. INFORMATION FOR DECISION MAKING

As we mentioned earlier, the control and decision-making processes are closely interwoven – study the following diagram:

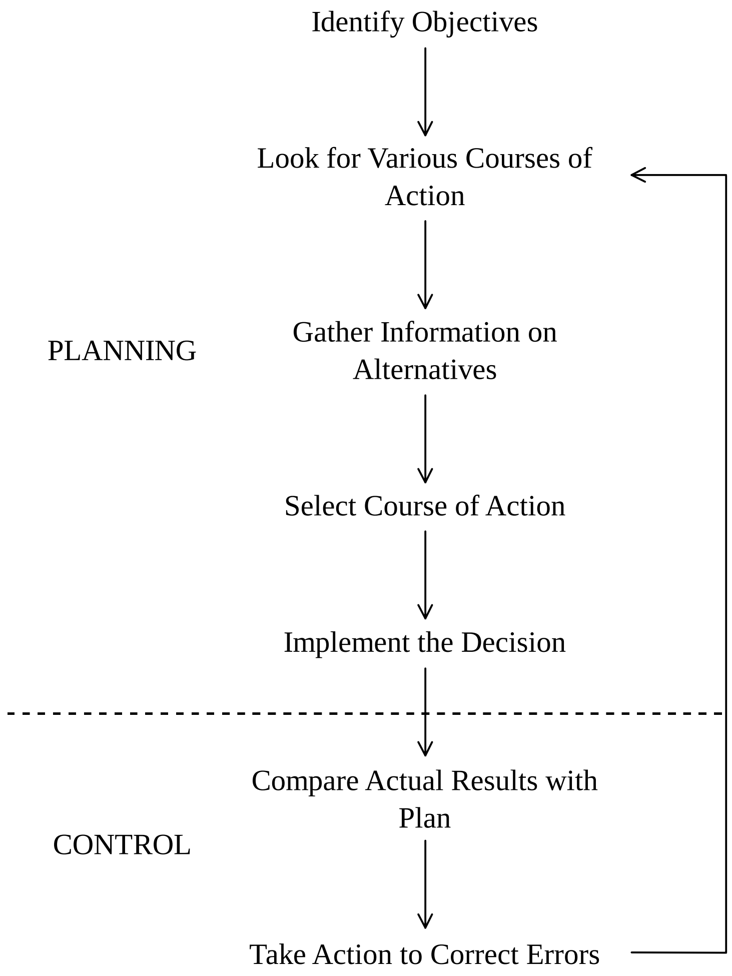

Figure 1.5: Control and Decision Making

You will see from this that the control element we have studied forms an integral part of the process. Note also the loop to allow us to make changes and see the effect this has on the system in order to decide if such changes were the right ones. If, for example, we have a pair of shoes priced at £30 per pair and we decide to reduce the price to £25 in order to shift some stock, we can then gather information on the impact of the price change on the sales volume. If volumes remain fairly static, we may decide to put the price back up or lower it still further and again measure the effect.

Planning is a long-term strategy and as such is determining the long-term view – the strategic view. Information must be collected on market size, market growth potential, state of the economy, etc. The implications of long-term strategic decisions will influence operating or short-term decisions for years to come and it is sometimes necessary to consider the operating decisions as part of the planning process. Examples of short-term decisions are:

- level of the selling price of each individual item
- level of production

- type of advertising
- delivery period
- level of after-sales service.

Study Unit 2

Cost Categorisation and Classification

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INTRODUCTION

Now that we have had an introduction to management accounts and the importance of information, we can start to look in more detail at how managerial accounting operates in practice. This study unit will describe the different ways in which costs can be classified in order to provide meaningful management information. You should always bear in mind that the ultimate purpose of any management accounting system is to provide information for management to make decisions.

In addition to cost classification, we shall look further at how costs behave under differing conditions – an important thing to understand when making decisions based on the information to hand – as well as how this information is likely to be presented to you.

A. ACCOUNTING CONCEPTS AND CLASSIFICATIONS

Financial Accounting

The accounts for limited companies are prepared and presented in accordance with the **Companies Act**, Statements of Standard Accounting Practice (SSAPs) and Financial Reporting Standards (FRSs). These legal and quasi-legal requirements endeavour to ensure that **uniform methods** are used in arriving at the profit or loss for the period and valuations for balance sheet purposes. The principles should already be familiar to you through your accounting studies. No similar set of guidelines or legal requirements applies to management accounting reports and statements, and therefore these are normally designed to meet the needs of the individual firm.

Management Accounting

(a) Categories of Cost

The following CIMA definitions relate to general concepts and classifications used in cost and management accounting. An understanding of these is a necessary starting point in your studies, before you commence the more detailed analyses which follow later in the course.

- ***Direct Materials***

  "The cost of materials entering into and becoming constituent elements of a product or saleable service and which can be identified separately in product cost."

- ***Direct Labour***

  "The cost of remuneration for employees' efforts and skills applied directly to a product or saleable service and which can be identified separately in product costs."

- ***Direct Expenses***

  "Costs, other than materials or labour, which can be identified in a specific product or saleable service."

- ***Indirect Materials***

  "Materials costs which are not charged directly to a product, e.g. coolants, cleaning materials."

- ***Indirect Labour***

  "Labour costs which are not charged directly to a product, e.g. supervision."

- ***Indirect Expenses***

  "Expenses which are not charged directly to a product, e.g. buildings insurance, water rates."

- ***Prime Cost***

  "The total cost of direct materials, direct labour and direct expenses. The term prime cost is commonly restricted to direct production costs only and so does not customarily include direct costs of marketing or research and development."

- ***Conversion Cost***

  "Costs of converting material input into semi-finished or finished products, i.e. additional direct materials, direct wages, direct expenses and absorbed production overhead."

- ***Value Added***

  "The increase in realisable value resulting from an alteration in form, location or availability of a product or service, excluding the cost of purchased materials or services.

  Note: Unlike conversion cost, value added includes profit."

- ***Overhead Cost***

  "The total cost of indirect materials, indirect labour and indirect expenses." (Note that overhead costs may be classified under the main fields of expenditure such as production, administration, selling and distribution, research.)

(b) Specimen Calculation

	£
Direct materials	X
Direct labour	X
Direct expenses	X
Prime cost	**X**
Production overhead	X
Manufacturing cost	**X**
Administration overhead	X
Selling and distribution	X
Total cost	**X**
Profit	X
Sales	**X**

Conversion cost = prime cost + production overhead absorbed or charged against production.

Value added = sales – direct materials and purchased services.

B. CATEGORISING COST TO AID DECISION MAKING AND CONTROL

Categorisation of costs is an important early step in the decision-making process; if it is carried out correctly it should become much easier to make decisions. Even though the cost data used is historical, correct categorisation can help in future assessment. Thus, if a cost is fixed (we shall look at this concept in more detail below) regardless of the level of activity, then it is an easy matter to assess its likely future impact on the business. Similarly, identifying those costs which the manager is able to influence is essential if those costs are to be properly controlled.

We shall now go on to look in more detail at several different methods of categorisation.

Fixed and Variable

Costs may be categorised according to the way they behave. This is a very important distinction which will be developed later and is a major factor in marginal costing and decision making.

(a) Fixed Costs

Fixed costs are costs that do not change as output either increases or decreases. Examples would include rent and rates.

(b) Variable Costs

Variable costs are costs that will change in direct proportion with the increase or decrease in output. For example, direct material costs will increase in direct proportion to any change in output.

(c) Semi-Fixed Costs

Semi-fixed costs will change with the increase or decrease in output. However, in this case there will not be a proportionate relationship. As its name implies, semi-fixed costs include elements of both fixed and variable costs. For example, telephone costs include a fixed element (the rental charge) and a variable call cost.

(d) Stepped Costs

Strictly speaking, these costs are fixed but change at a certain point in volume. For example, we have already seen that rent is a fixed cost but this only applies up to a certain level of volume; it is likely that new premises would be required when volume exceeds this optimum point, but then this element of cost would remain fixed until those new premises were outgrown, and so on.

Ultimately all costs are variable but the time-scales concerned vary for all costs and so some never change. This classification applies to a number of costs found in industry and commerce. However, in order to aid decision making it is necessary to break down these costs into their fixed and variable components. Details on how this is achieved will be given later in the course.

Relevant and Common Costs

When managers are deciding between various courses of action, the only information which is useful to them is detail about what would be changed as a result of their decision, i.e. they need to know the **relevant costs** (or incremental or differential costs). The CIMA defines relevant costs as “costs appropriate to aiding the making of specific management decisions”.

Common costs are those which will be the same in the future regardless of which option is favoured, and they may be ignored. A frequent example of this is fixed overheads; you may be told a fixed overhead absorption rate, but unless there is evidence that the total fixed overhead costs would change as a result of the decision, fixed overhead may be ignored.

Opportunity Costs

An opportunity cost is “the value of a benefit sacrificed in favour of an alternative course of action”. This is an important concept, and the following example gives you practice in using opportunity costs.

Example

Itervero Ltd, a small engineering company, operates a job order costing system. It has been invited to tender for a comparatively large job which is outside the range of its normal activities and, since there is surplus capacity, the management are keen to quote as low a price as possible.

It is decided that the opportunity should be treated in isolation without any regard to the possibility of its leading to further work of a similar nature (although such a possibility does exist). A low price will not have any repercussions on Itervero’s regular work.

The estimating department has spent 100 hours on work in connection with the quotation and they have incurred travelling expenses of £1,100 in connection with a visit to the prospective customer’s factory overseas. The following cost estimate has been prepared on the basis of their study:

Inquiry 205H/81

Cost Estimate

	£
Direct material and components	
2,000 units of A at £50 per unit	100,000
200 units of B at £20 per unit	4,000
Other material and components to be bought in (specified)	25,000
	129,000
Direct labour	
700 hours of skilled labour at £7 per hour	4,900
1,500 hours of unskilled labour at £4 per hour	6,000
Overhead	
Department P – 200 hours at £50 per hour	10,000
Department Q – 400 hours at £40 per hour	16,000
Estimating department	
100 hours at £10 per hour	1,000
Travelling expenses	1,100
Planning department	
300 hours at £10 per hour	3,000
	171,000

The following information has been brought together.

- Material A: this is a regular stock item. The stock holding is more than sufficient for this job. The material currently held has an average cost of £50 per unit but the current replacement cost is £40 per unit.
- Material B: a stock of 4,000 units of B is currently held in the stores. This material is slow-moving and the stock is the residue of a batch bought seven years ago at a cost of £20 per unit. B currently costs £48 per unit but the resale value is only £36 per unit. A foreman has pointed out that B could be used as a substitute for another type of regularly used raw material which costs £40 per unit.
- Direct labour: the workforce is paid on a time basis. The company has adopted a "no redundancy" policy and this means that skilled workers are frequently moved to jobs which do not make proper use of their skills. The wages included in the cost estimate are for the mix of labour which the job ideally requires. It seems likely, if the job is obtained, that most of the 2,200 hours of direct labour will be performed by skilled staff receiving £7 per hour.
- Overhead – Department P: Department P is the one department of Itervero Ltd that is working at full capacity. The department is treated as a profit centre (see later) and it uses a transfer price of £50 per hour for charging out its processing time to other departments. This charge is calculated as follows:

	£
Estimated variable cost per machine hour	20
Fixed departmental overhead	16
Departmental profit	14
	50

- Department P's facilities are frequently hired out to other firms and a charge of £60 per hour is made. There is a steady demand from outside customers for the use of these facilities.
- Overhead – Department Q: Department Q uses a transfer price of £40 for charging out machine processing time to other departments. This charge is calculated as follows:

	£
Estimated variable cost per machine hour	16
Fixed departmental overhead	18
Departmental profit	6
	40

- Estimating department: the estimating department charges out its time to specific jobs using a rate of £10 per hour. The average wage rate within the department is £5 per hour but the higher rate is justified as being necessary to cover departmental overheads and the work done on unsuccessful quotations.
- Planning department: this department also uses a charging out rate which is intended to cover all departmental costs.

You are required to restate the cost estimated by using an opportunity cost approach. Make any assumptions that you deem to be necessary and briefly justify each of the figures that you give.

Solution

Cost Estimate Using Opportunity Cost Approach

	£	*Notes*
Direct material and components:		
Material A – 2,000 units at £40	80,000	*(a)*
Material B – 200 units at £40	8,000	*(b)*
Other material and components	25,000	
	113,000	
Direct labour	-	*(c)*
Overhead:		
Department P – 200 hours at £60 per hour	12,000	*(d)*
Department Q – 400 hours at £16 per hour	6,400	*(e)*
Estimating department	-	*(f)*
Planning department	-	*(g)*
Opportunity cost of accepting job	131,400	

Notes

(a) As a result of using Material A on this job, future requirements will have to be bought at a price of £40. The replacement cost is therefore the opportunity cost.

(b) If Material B was not used on this job, the best use to which it could be put would be as a substitute for the other raw material. The cost of this material, £40, is therefore the opportunity cost. The replacement cost of B, £48, is not relevant, since this stock has been held for seven years, and it seems unlikely that the material would be replaced.

(c) The skilled labour which will be used on this job will be paid £7 per hour, whether or not this job is taken. Assuming that no extra labour will be hired as a result of this job, the opportunity cost is nil.

(d) Since Department P is working at full capacity, any extra work that must be done in this department would mean that the company forgoes the opportunity to hire out the facilities to other firms. The opportunity cost of using Department P's facilities is therefore £60 per hour.

(e) The cost per hour of £40 for Department Q includes two items which are not relevant to this decision. The fixed departmental overhead of £118 would be incurred anyway, even if this job is not undertaken, and can therefore be excluded. The departmental profit of £16 can also be excluded, since we are giving an estimate of cost, on to which, hopefully, a profit margin will be added. The relevant cost is therefore the incremental cost incurred per hour in Department Q, i.e. £16 per hour.

(f) None of the costs of the estimating department will **now** be affected by a decision to accept this job. The wages and travelling expenses incurred are past or sunk costs (see later), and are not relevant to the opportunity cost estimate.

(g) All of the planning department costs seem to be costs that will be incurred anyway, regardless of whether or not this job is accepted. They are not, therefore, relevant to the decision.

N.B. If you are given this type of question in the examination, it is important that you state clearly any assumptions that you make. Your point of view on what constitutes a relevant cost may differ from that of the examiner, so it is vital that you discuss your reasoning in your answer.

Usefulness of Opportunity Costs

Opportunity costs should be used with caution. They were useful in the example given above, because the lowest possible price was required, and we were told that a low price on this job would not have any repercussions on Itervero's regular work.

It is important that managers do not lose sight of the need to cover past costs and fixed costs in the long run (e.g. the travelling expenses, in this example) in order to make profits.

Bearing this in mind, it is essential that you have all relevant information to hand. In any examination questions, you should always look out for past costs.

Controllable and Uncontrollable Costs

The distinction between these two classifications depends upon management's ability to influence cost levels.

- **Controllable** costs include those expenses that can be controlled by the respective manager.
- **Uncontrollable** costs include those expenses that cannot be controlled by the respective manager. Such expenses may include rent, rates and depreciation.

Classification of a cost as either "controllable" or "uncontrollable" will probably be influenced by the manager's position within the business. A director will be able to influence more costs than a departmental manager.

Control over managers' financial performance will be exercised through the company's budgetary control system. The distinction between controllable and uncontrollable costs is therefore very important. Managers should be held accountable only for the costs over which they have control. In practice you may find statements which, for example, apportion some administrative overheads to each manager. In this case administrative overspends may feature on the line manager's control statement even though he or she is not in a position to control these expenses. This type of approach can have dysfunctional effects on the company and should be avoided if possible.

Incremental Costs

The CIMA definition of incremental costing is:

> *"A technique used in the preparation of ad hoc information where consideration is given to a range of graduated or stepped changes in the level or nature of activity, and the additional costs and revenues likely to result from each degree of change are presented."*

Put simply, they are the additional costs incurred as a consequence of a decision and can be used where these options are being considered.

Incremental costing is useful in deciding on a particular course of action where the effect of additional expenditure can be measured in sales. This is commonly applied to advertising expenditure and the incremental increase in revenue.

Suppose, for example, that a particular company with sales of £2 million and an annual advertising budget of £75,000 earns a contribution from sales of £700,000. Additional advertising expenditure would increase sales at the following rate:

	Increase in Advertising	Increase in Sales %
	£5,000	1
Additional	£5,000	0.5
Additional	£5,000	0.25

We can now calculate the effect of the incremental advertising expenditure on sales and compare this to the additional contribution earned to ascertain if it is worth undertaking.

	Increase in Advertising £	Increase in Sales £	Increase in Contribution £	Marginal Profit/(Loss) £
	5,000	20,000 (1%)	7,000 (35%)	2,000
Additional	5,000	10,000 (0.5%)	3,500	(1,500)
Additional	5,000	5,000 (0.25%)	1,750	(3,250)

As you can see, the extra benefit from increasing the advertising expenditure only extends to the first additional £5,000. Thereafter the additional contribution earned does not cover the additional expenditure.

Other Definitions

(a) Avoidable Costs

These are defined as "Those costs, which can be identified with an activity or sector of a business and which would be avoided if that activity or sector did not exist."

The concept of avoidable cost applies primarily to shut-down and divestment decisions and numerical examples of these will be covered in a later study unit.

(b) Committed Costs

These are costs already entered into but not yet paid, which will have to be paid at some stage in the future. An example would be a contract already entered into by an organisation.

(c) Sunk Cost

This is a cost that has already been incurred. The money has been spent and cannot be recovered under any circumstances.

For example, £20,000 may have been spent on a feasibility study for a particular project that a property development firm is considering undertaking. A further £250,000 needs to be spent if the project goes ahead which will generate income of £260,000. In this situation the sunk costs may be ignored and the decision on whether to continue with the project can be made by comparing future sales with future costs. Assuming that there are no non-financial reasons for not continuing with the project then it should be undertaken, as it will generate additional sales of £260,000 and incur additional costs of £250,000. As a result the business will be £10,000 better off.

However, it must be stressed that in the long term a company must recover all costs, and even though in this example it pays the company to proceed with the project, it must not lose sight of the fact that it has actually lost £10,000 on the order.

(d) Notional Cost

A company may include a cost in its profit and loss account even though the cost has not been incurred. For example, a holding company may control subsidiaries that own land and other subsidiaries that have to pay rents. This "accident of history" may distort the operating performances of these subsidiary companies, and to compensate for this, the holding company may decide that companies will prepare accounts as if all the property was rented. In this case those subsidiaries that own land will charge a notional rent cost in their accounts. In this way a meaningful comparison can be made between each company's operating performance.

A Worked Example of Relevant Costing

New Facility PLC is currently undertaking a research project which to date has cost the company £300,000. This project is being reviewed by management. It is anticipated that should the project be allowed to proceed, it will be completed in approximately one year, when the results are expected to be sold to a government department for £600,000. The following is a list of additional expenses which the Board of Directors estimate will be necessary to complete the project:

(a) Materials – £120,000

This material, which has just been delivered, is toxic and if not used in the project would have to be disposed of by a specialised contractor at a cost of £15,000.

(b) Labour – £80,000

Personnel employed on the project are difficult to recruit and were transferred from a production department. At a recent directors' meeting the Production Director requested that these members of staff should be returned to the production department because they could earn the company an additional £300,000 sales in the next year. The Management Accountant calculates that the prime cost of these sales would be £200,000 and the fixed overhead absorbed would be £40,000.

(c) Research Staff – £120,000

A decision has already been made that this will be the last research project undertaken by the company, consequently when work on this project ceases the specialist research staff employed will be made redundant. Redundancy and other severance pay is estimated to be £50,000.

(d) Share of General Business Services – £75,000

The directors are not sure what specifically is included in this cost but a similar charge is made each year to each department.

Required: assuming the estimates are accurate, advise the Board of Directors on the course of action to take. You must explain the reasons for your treatment of each item, carefully and clearly.

Suggested Solutions

The first thing to do when answering questions like this is to define the possible courses of action.

These are:

- To terminate the project immediately; this means the production workers can be redeployed on alternative work.

- To continue the project for another year and sell the results to the government department.

A financial comparison must be made of the two options, using both relevant and differential costing.

You can either work out the costs and benefits of terminating the project or continuing with it.

Costs and Benefits of Continuing With the Project

	£	£
Sale proceeds of the project work		600,000
Cost saving of using the material *(a)*		15,000
Total expected benefit		615,000
Total relevant cost of continuing with the project		
Labour cost of project *(b)*	80,000	
Contribution lost by using production labour *(c)*	100,000	
Research staff costs *(d)*	120,000	(300,000)
Contribution earned by continuing with the project		315,000

Notes and Workings

(a) The disposal cost of material is a benefit because it will only be incurred if the project is discontinued.

(b) The production labour cost is included because it is a direct cost of the project.

(c) This figure is calculated as follows:

	£
Sales revenue earned by production labour engaged in alternative work	300,000
less Prime cost of this work	(200,000)
Contribution – this is an opportunity cost of continuing with the project	100,000

(d) This cost is included because it will only be incurred if the project continues.

The following costs are not relevant:

- The cost to date of £300,000; this is a sunk cost.
- Material costs of £120,000; this is a sunk cost – the materials are already in stock.
- Fixed production overhead £40,000; this cost is not relevant to the project.
- Research staff redundancy costs of £50,000; this cost is not relevant as it will be incurred whether the project is terminated or continues. The question states that this is the last research project the company will undertake.
- General business services £75,000; this is an arbitrary apportionment of an overhead and is not relevant to the project.

Recommendation: based upon financial information alone the project should be proceeded with as it results in an expected contribution of £315,000.

Other factors which should also be taken into account are:

- How certain it is that the results will be purchased by the government department.
- If the project continues the directors can review their decision to discontinue further research work in one year's time.
- How certain it is that production workers can be used on alternative work.
- To discontinue the project would lead to a reduction in labour morale in the company.
- Competitors may recruit research staff if the project is discontinued. Competitors will then benefit from the work.

(Note carefully how the topics covered in this study unit relate to this decision-making question.)

C. MANAGEMENT RESPONSIBILITY LEVELS

Cost Centre

This is any unit within the organisation to which costs can be allocated, and is defined by CIMA as "a location, function or items of equipment in respect of which costs may be ascertained and related to cost units for control purposes". It could be in the form of a whole department or an individual, depending on the preferences of the organisation involved, the ease of allocation of costs and the extent to which responsibility for costs is decentralised.

Thus an organisation which prefers to make senior management alone responsible will probably have very few centres to which costs are allocated. On the other hand, firms which allocate responsibility further down the hierarchical ladder are likely to have many more cost centres.

If we were to take as an example a small engineering firm, it may be the case that it is organised so that each machine is a cost centre. It may also be the case, of course, that it is not always beneficial to have too many cost centres. This is partly because of the administrative time involved in keeping records, allocating costs, investigating variances and so on, but also because an operative of a single machine, for instance, may have no control over the costs of that machine in terms of power, raw materials, etc., along with any apportioned cost.

This brings us to another point, which is the distinction between the direct costs of the centre and those which are apportioned from elsewhere (e.g. general overheads). Although it is important to allocate out as much cost as possible, it must also be remembered that the cost centre has no control over the apportioned cost. This is important when considering who is responsible for the costs incurred.

Service Cost Centres

These generally have no output to the external market but provide support internally.

Revenue Centres

These are concerned with revenues only, and are described in the CIMA Official Terminology as "a centre devoted to raising revenue with no responsibility for production, e.g. a sales centre, often used in a not-for-profit organisation". In a commercial organisation therefore it may be that a particular marketing department would be judged on its level of sales. The drawback of this approach, however, is that it gives no indication as to the profitability of those sales.

Profit Centres

As their name suggests, profit centres are areas of the organisation for which sales and costs are identifiable and attributable, and are defined by CIMA as "a segment of the business entity by which both revenues are received and expenditures are caused or controlled, such revenues and expenditure being used to evaluate segmental performance". A profit centre will usually contain several cost centres and thus will be a much larger unit than a cost centre. To be effective, the person responsible must be able to control the level of sales as well as the levels of cost being incurred. Where a profit centre does not sell to the external market but instead provides its output to other areas of the organisation internally, then its performance may well be judged by the use of transfer prices. This will be the sales value to the profit centre concerned and the cost to the centre to which the output is transferred.

Investment Centres

In this final example the manager of the unit has discretion over the utilisation of the capital employed. CIMA defines it as "a profit centre in which inputs are measured in terms of expenses and outputs are measured in terms of revenues, and in which assets employed and also measured, the excess of revenue over expenditure then being related to assets employed".

An investment centre is therefore the next step up from a profit centre and is likely to incorporate several of the latter.

D. COST UNITS

An important part of any costing system is the ability to apply costs to cost units. The CIMA Official Terminology describes cost units as "A quantitative unit of product or service in relation to which costs are ascertained".

Thus, a cost unit in a hospital might be an operation or the cost of a patient per night. Generally, such terms are not mutually exclusive, although it is of course better to take a consistent approach to aid comparison. Once the cost system to be used by the particular organisation has been identified, costs can be coded to it (we shall look at cost codes in more detail shortly) and its total cost built up. This figure can then be compared with what was expected or what happened last year or last month and appropriate decisions taken if action is required.

The point is that the organisation is able to identify the lowest item in the system that incurs cost, which can then be built up into the total cost for a cost centre by adding all the costs of the cost units together. By adding sales values to the cost units the cost centre becomes a profit centre.

It is not always possible to identify exactly how much cost has been incurred by a particular item; in certain instances it is not possible to allocate cost except in an arbitrary way. It could be that the costing system in use is not sophisticated enough to cope.

Different organisations will use different cost units; in each case it will be the most relevant to the way they operate. Here are a few examples:

- Railways – cost per tonne mile.
- Airlines – cost per flight/cost per passenger.
- Manufacturing – cost per batch/cost per contract.
- Oil extraction – cost per 1,000 barrels.
- Textile manufacture – cost per garment.

- Football clubs – cost per match.
- Car manufacture – cost per vehicle.

E. COST CODES

Having looked at how costs are identified in order to build up the costs incurred by cost units and cost centres, it is useful at this point to look briefly at how the physical allocation of such costs is undertaken. Costs are allocated by means of cost codes, which is defined by CIMA as:

> *"A system of symbols designed to be applied to a classified set of items, to give a brief accurate reference facilitating entry, collation and analysis."*

Every business will have its own coding system unique to the way it is organised and the types of cost it incurs. Some will be more complex than others, but remember the objective of any coding system is to allocate costs accurately and consistently, to aid interpretation and decision making.

The CIMA definition goes on to cite an example:

> *"... in costing systems, composite symbols are commonly used. In the composite symbol 211.392 the first three digits might indicate the nature of the expenditure (subjective classification), while the last three digits might indicate the cost centre or cost unit to be charged (objective classification)".*

Alternatively, a coding system might be set up with the objective classification before the subjective classification. For instance, an insurance company, which operates on a nationwide basis, may have a centralised system for paying overheads which need to be allocated to its divisions. Each division is also split into three regions, all of which operate as cost centres. The following is an example of how it might be set up:

Southern 30

- Thames Valley 01
- S. West 02
- Wessex 03

Midlands 40

- E.Anglia 11
- Central 12
- E. Mids 13

Northern 50

- Yorks 21
- Lancs 22
- Cumbria 23

Thus, each region within a division has a four digit stem code which is used to allocate costs to it. In addition to the above, there will be a list of overhead codes which cover all the different types of cost incurred, such as salaries, rent and rates of office buildings, telephones, entertaining expenses and so on. Suppose that the following is an extract from the overhead code listing:

Salaries:	Administration	1100	
	Sales	1200	
	Marketing	1300	
Office Expenses:	Telephones	2100	
	Rent and Rates	2200	
	Cleaning	2300	

The overhead codes used need not be four digit as we have shown; they could be two, three, five or whatever, depending on how the system is set up.

The cost code for Marketing salaries in Lancashire, for example, would therefore be 50 22 1300 and for cleaning in Wessex it would be 30 03 2300. The list of codes used would, of course, be much more extensive than that shown, in order to make coding a simple exercise which is not open to subjectivity, so that those using the costing information can be confident that it is accurate and consistent.

The important elements of a good coding system are as follows:

- The coding system should be simple to operate.
- It should be capable of being easily understood by non-financial managers.
- It should be logical so that where there are a number of people responsible for coding items, it is easy to be consistent.
- The coding system should allow for expansion so that new costs can be easily incorporated without the need for major changes.
- All codes should be issued centrally to avoid confusion or duplication.

F. PATTERNS OF COST BEHAVIOUR

Costing systems are designed to collect information on historic costs but what they are not designed to do is provide information on what those costs will be in the future. This is the remit of the management accounting function, which will take this historic cost and extrapolate it forward for the length of time under consideration.

In order to predict with confidence, it is necessary to know exactly how these costs will behave in the future. We have already seen that costs may be categorised as fixed, semi-variable or variable and it is therefore important to know into which category such costs will fall in the future.

Furthermore, it is also necessary to know what influences will cause such costs to change. It could be, for instance, that supervising costs have remained static in the past, but suppose that turnover is forecast to rise in the future to the critical point at which more supervising costs are needed (this is known as a “stepped cost” which we shall look at in more detail shortly). To be accurate in our forecasting we need to know not only that supervising costs do display this tendency but also, and more importantly, the point at which the change is reached.

When considering cost behaviour it is important to remember that we are only considering situations in which changes in activity cause any changes in the level of cost incurred. We shall look at other influences on changes in cost behaviour later.

Fixed Costs

We have already defined a fixed cost as one that does not vary with output. In graphical terms we can show total fixed costs as follows:

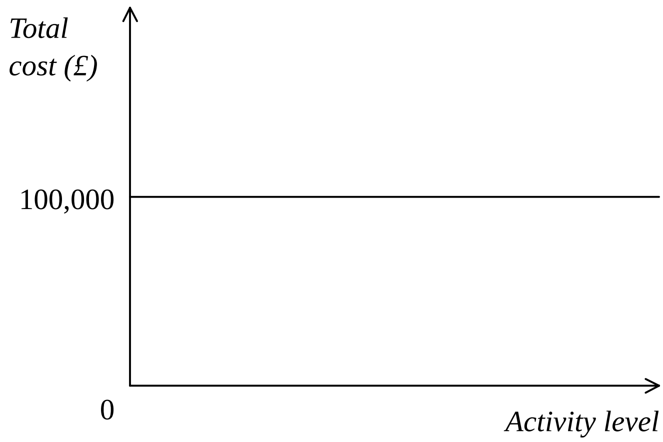

Figure 2.1: Total Fixed Costs

Thus, if we have fixed costs of £100,000 and produce one unit of production, the cost per unit is £100,000, but if we produce 100,000 units the unit cost falls to £1.

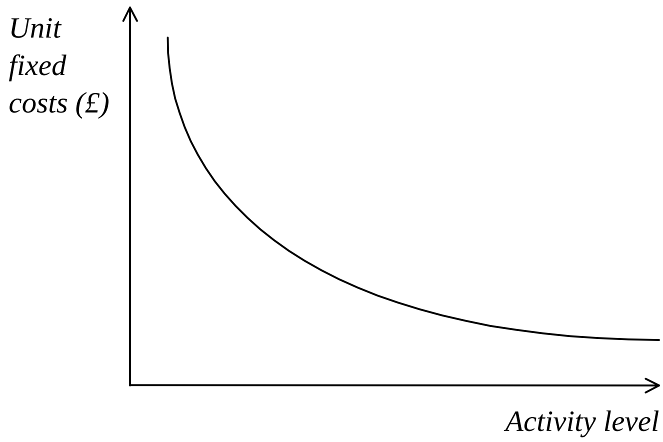

Figure 2.2: Unit Fixed Costs

Variable Costs

These are costs which do vary directly with the level of output, so that if £1 worth of material is used in the production of one unit, then £10,000 worth will be used in the production of 10,000 units. This presupposes that no bulk-purchase discounts are available and there is no wastage (or at least it is at a constant rate per unit).

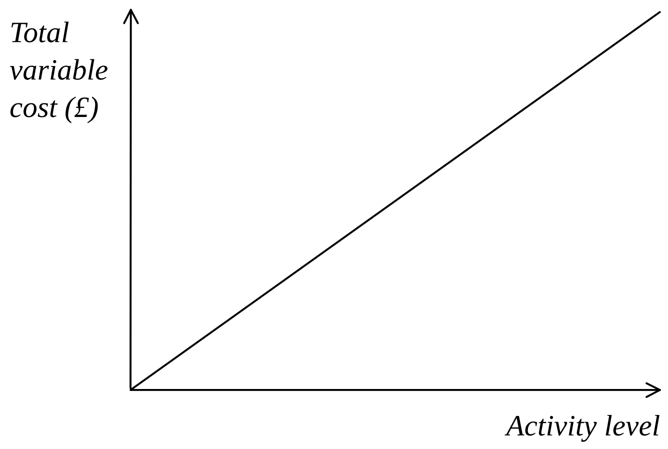

Figure 2.3*: *Total Variable Cost

The following graph indicates that the variable cost per unit remains constant.

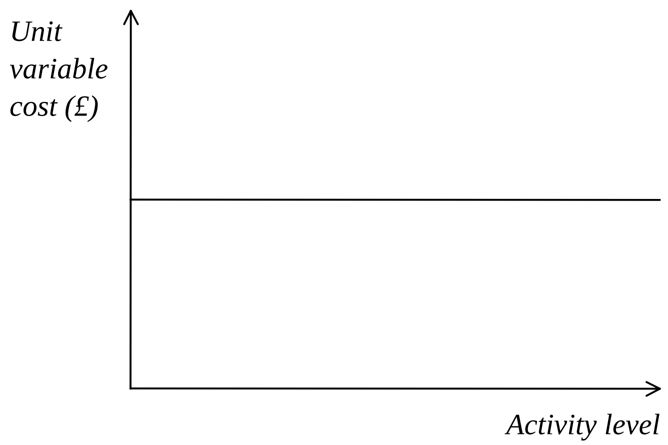

Figure 2.4*: *Unit Variable Costs

Stepped Costs

These are costs which are fixed up to a certain point but vary after this point, and are then fixed once again.

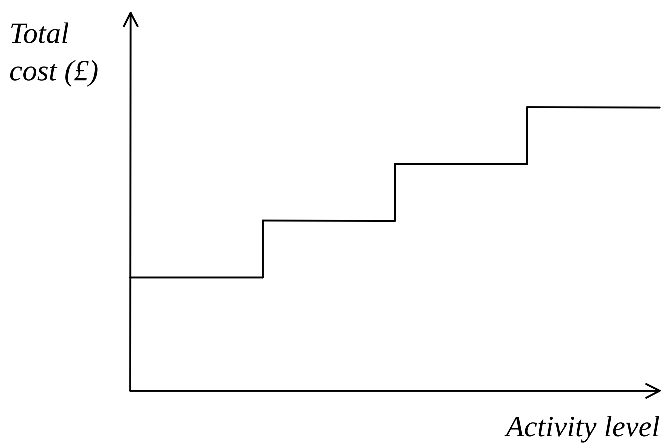

Figure 2.5: Stepped Cost

Wages and salaries are an example of this type of cost; the number of employees will be constant up to a certain level, after which more employees will be required.

Fixed asset depreciation is another example of this type of cost; the amount will be fixed for each asset owned but the total cost will vary with the number of machines.

Semi-Variable Costs

This type of cost incorporates both fixed and variable elements; a good example would be a gas or electricity bill which has a fixed charge regardless of usage and a variable charge based on the number of units consumed.

Other Cost Behaviour Patterns

Bulk-purchase discounts may have an important effect on the cost per unit of an item; the effect will depend very much upon how the discount is applied. Three possibilities are shown in the following figures.

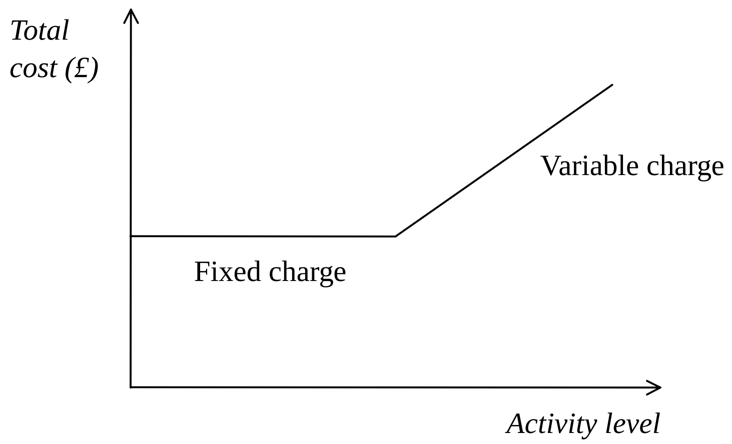

Figure 2.6: Fixed minimum charge, variable with output

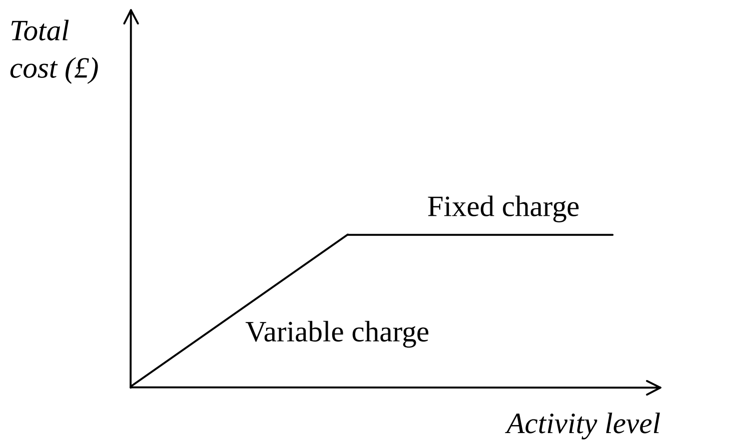

Figure 2.7: Variable charge, fixed above certain activity level

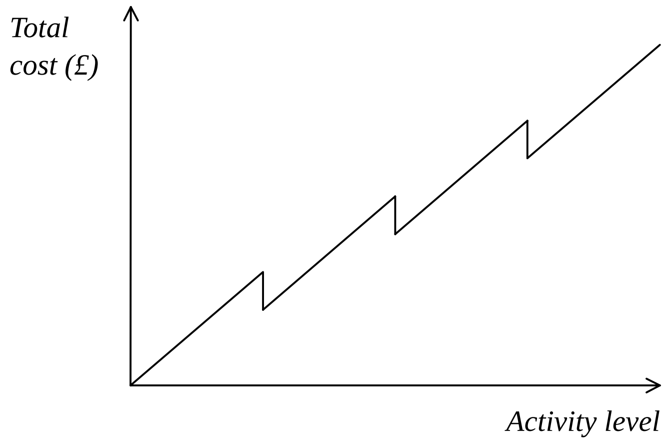

***Figure 2.8**: Retrospectively applied discount at set activity levels*

G. INFLUENCES ON ACTIVITY LEVELS

We have already seen that the distinction between a cost being fixed or variable is affected by activity of the business concerned. It is useful, therefore, to consider the influences that can change the current or expected level of activity.

- **Capacity levels**: less cost will be incurred if the company is operating below full capacity, as there is less likelihood that new plant and machinery is required, with resultant lower set-up costs.
- **Time-scales involved**: if the increase in activity is short-lived, it may be possible to cope with existing resources.
- **Labour force**: greater automation and mechanisation may mean that increased activity levels may be absorbed at lower cost. Labour-intensive industries may need to take on additional workers.
- **Economic climate**: a strong general economy may mean that the company will have difficulty in obtaining the necessary resources to cope with an increase in activity.

H. NUMERICAL EXAMPLE OF COST BEHAVIOUR

To finish off this area, it will be useful to look at a numerical example of the effects of activity on different types of cost.

An architects' practice employing 10 staff has an annual salary bill of £240,000 including on-costs such as National Insurance and provision of vehicles where appropriate. The office has four Computer Aided Design (CAD) machines that cost £6,000 each new and are depreciated over three years. Office rental is £25,000 per annum, fixed office costs (cleaning, office equipment, maintenance, etc.) is £10,000 per annum and there are variable costs that vary with the level of work undertaken at the rate of £4,000 per contract undertaken. Each contract has an approximate value of £20,000.

At present 18 contracts are expected to be completed in the current financial year. One new contract will require an extra employee, but a further new contract could be undertaken with the increased workforce. What is the financial position now and what would it be with one and two additional contracts?

The current position is as follows:

		£	£
Sales (18 × £20,000)			360,000
less:	Salaries	240,000	
	Office Rental	25,000	
	Variable Office Costs (18 × £4,000)	72,000	
	Fixed Office Costs	10,000	
	Depreciation (4 × £20,000)	8,000	355,000
Net Profit			5,000

Now let us see what the position is with a change in the level of activity when one new contract is undertaken and the cost base alters.

		£	£
Sales (19 × £20,000)			380,000
less:	Salaries	264,000	
	Rental	25,000	
	Variable Office Costs (19 × £4,000)	76,000	
	Fixed Office Costs	10,000	
	Depreciation (5 × £20,000)	10,000	385,000
Net Loss			5,000

You can see from this scenario that the increase in activity has led to increases in costs that appeared fixed at the lower level, namely salaries and depreciation. In effect these have become stepped costs. The profit of the contract taken in isolation is:

	£	£
Sales		20,000
Variable Cost	(4,000)	
Salary Increase	(24,000)	
Depreciation Increase	(2,000)	(30,000)
Net Loss		10,000

With the second additional contract the position alters to:

	£	£
Sales (20 × £20,000)		400,000
Salaries	(264,000)	
Office Rental	(25,000)	
Variable Office Costs	(80,000)	
Fixed Office Costs	(10,000)	
Depreciation	(10,000)	(389,000)
Net Profit		11,000

So we can see that the contract has improved the profitability by £16,000 (£20,000 increased sales value less the increase in variable costs of £4,000). Note also that salaries and depreciation have once again become a fixed cost when viewed purely in terms of this transaction.

Study Unit 3

Direct and Indirect Costs

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INTRODUCTION

Having studied cost units with various categorisations of cost, and the various management responsibility levels, in this study unit we will concentrate on the costs themselves. The usual split is between direct and indirect; the former can be identified with the associated unit of production, whilst the latter have to be allocated, apportioned or expensed according to the particular system in use.

A. MATERIAL COSTS

When considering the unit cost of an item, the three major elements of direct cost are materials, labour and direct production overhead. The last two elements will be considered shortly, so we will look at materials in more detail now.

Material Control Systems

Expenditure on materials may be a major part of total cost, so that a sound system of control through all stages from purchasing to conversion into finished goods is essential. Material control systems are often computerised and provide essential links with the financial, cost and management accounting systems. In order for the control system to be effective, requests for the purchase of materials must only be made by suitably authorised personnel and must be made to the purchase officer, who can co-ordinate the requirements of several departments.

The purchasing officer should maintain records so that the best possible terms can be obtained for the goods required. (This will usually mean the best possible price, but occasionally it may be necessary to accept a higher price, for instance to obtain speedier delivery.)

Stock Levels

In order to ensure that the flow of production is not impaired by a lack of materials, and also that excessive capital is not tied up in stocks, it is necessary to make sure that the level of stock held always lies between certain limits.

(a) Maximum Quantity

This represents the **greatest amount of an item of stock which should be carried**, if the best use of working capital is to be made.

In determining the maximum stock level, the following are among the factors to be considered:

- **Capital** tied up in stocks.
- Cost of **storage** (including rent, insurance, labour costs).
- **Storage space** available.
- **Consumption** rate.
- **Economic purchasing quantities**.
- **Market conditions** and **prices** and **seasonal** considerations.
- **Nature of the material** – possible deterioration or obsolescence.

(b) Minimum Quantity

This represents the **level below which the stock should not normally be allowed to fall** if the requirements of production are to be met.

The minimum level is determined by the rate of consumption of materials and the time taken between placing an order and receiving the material.

(c) Reorder Level

It is necessary to set a point at which an order must be placed. This point is known as the **reorder level**. It will be higher than the minimum level, to cover use during the period before the order is received (the reorder period).

(d) Reorder Quantity

The reorder quantity is the quantity which **should be ordered** at the time the reorder level is reached. It will depend on the discounts available from suppliers for bulk ordering, the cost of placing an order and the cost of storage.

Economic Order Quantity

There is a formula which indicates to a company the **optimum batch size** in which to purchase goods. The formula is:

$$Q = \sqrt{\frac{2DS}{H}}$$

where: Q = the economic order quantity;

D = the annual demand for the product;

S = is the fixed cost of placing an order, i.e. delivery charges, clerical time in placing the order, checking invoice, etc. which does not vary with the size of the order; if the goods are produced internally it will include fixed production costs incurred specifically in producing the batch, e.g. tool setting; and

H = the annual cost of holding one unit of stock.

Notice that the model is rather limited. The unit cost is assumed to be constant. There is no provision for quantity discounts which might make it more attractive to purchase larger quantities.

Example

A company uses 4,000 components of type A in a year. The cost of placing an order is £20. The stockholding cost is £4 per item per year. Stocks are replenished when the stock level falls to 50 units; orders placed are received the same day. Calculate the economic order quantity.

Solution

Using the formula: $Q = \sqrt{\frac{2DS}{H}}$

Then: $Q = \sqrt{\frac{2 \times 4{,}000 \times 20}{4}}$

$= \sqrt{40{,}000}$

$= 200$

Therefore, orders should be placed for batches of 200 units at a time.

Materials Control – Accounting Records

(a) Perpetual Inventory and Continuous Stocktaking

When the balances of stock are recorded after each issue or receipt of materials, a perpetual inventory is in operation. This can be combined with a continuous stocktaking system, whereby a few items are physically counted every day.

The advantages of this system are as follows:

- The temporary dislocation of work caused by end-of-period stocktaking is avoided.
- The daily checking of items can be so arranged that all items are checked at least twice a year, but fast-moving or valuable lines can be checked more frequently.
- Explanations of differences between physical stock and records can be made more easily and perhaps measures can be taken to prevent recurrence.
- There is a greater morale effect on the staff.
- The annual accounts can be prepared earlier, as the book value of the stores is acceptable for balance sheet purposes. The stock value can also be used to prepare monthly accounts.
- The opportunity can be taken to check that maximum stock levels are not being exceeded, so the disadvantages of excessive stocks are more easily avoided.

(b) Accounting of Waste and Scrap

There are three main categories of waste and scrap in the context of materials handling and accounting:

- **Waste material** such as trimmings and offcuts – this should be controlled within reasonable limits. Records can show waste as a percentage of material used. This type of waste will be collected and periodically sold, destroyed or dumped.
- Offcuts and other waste from one process may be suitable for **making other things**. Such material is returned to store.
- A proportion of finished output will be **rejected on inspection**, and will either be sold as scrap or will be subjected to further processing to make it suitable for sale.

Scrap and waste are considered in greater depth later in the course under “Process Costing”.

(c) Pricing and Accounting for Materials Issues

In times of changing prices, firms have to make a decision as to how they will price the materials issued to production when they are trying to arrive at **overall production costs**. Should it be the price they actually paid for the material, or the current price of the same type of material (which could well be higher)?

There is also the question of the valuation of **closing stock** – which, you already know, affects the reported profit, since a manufacturer, in drawing up his manufacturing account, will use the formula:

Opening stock + Purchases – Closing stock = Cost of materials consumed.

(We must not confuse the profit from manufacturing with the paper profit which could arise in a time of rapidly rising prices as stocks become worth more than the firm paid for them.)

It must be emphasised that, when we talk about pricing of material issues, it does not matter which materials are actually, physically, issued to production. A good storekeeper will issue the oldest materials first, especially if the materials are perishable. But that does not mean that a firm must charge production with the cost of those particular materials, if management feels that that would not adequately reflect current conditions.

Materials Handling Costs

(a) Nature of Costs Incurred

The costs of transportation, storage, movement and administration of materials may include such items as:

- carriage outward, packing and despatch
- van and transport costs
- rent, rates and insurance of stores
- light, heat and power related to stores, etc.

These and any other related costs must be absorbed into production or product costs.

(b) Methods of Absorbing Costs

Various methods are found in practice of "absorbing costs" into a total cost figure. These include:

- **Adding a percentage loading** to the cost of materials used,
- Including the costs in **production overheads**,
- Using a rate based upon the **volume or weight** of materials,
- Inclusion in **selling and distribution costs**.

The choice of method or methods to be adopted will depend upon the amount of cost involved and the policy of the organisation. The inclusion of the costs in general production overheads is the simplest method, but it is likely to be the least accurate, as the volume or value of materials may vary from one job or product to another. This aspect is dealt with in greater detail later in the course.

B. LABOUR COSTS

Controlling Direct Labour Cost

All elements of labour cost should be subject to a control system. We are going to discuss here the factors to be considered when dealing with that section of labour cost which can be wholly and exclusively attributed to particular cost units (i.e. direct labour). The balance of labour costs – indirect labour – will be dealt with when we consider overheads. Thus direct labour is more applicable to manufacturing industry where labour costs will form part of the total cost of the physical item produced. Indirect labour cost allocation is therefore more relevant in service industries.

Timekeeping and Time Booking

(a) Records to be Kept

Records must be kept of the following:

- Time spent in the factory, in respect of which the worker is entitled to draw wages. This is known as "timekeeping", and relates to all labour employed by the organisation (whether direct or indirect).
- Time spent on individual cost units – "time booking", i.e. the recording of time spent on each cost unit, is necessary so that the correct labour cost for each job can be ascertained. By implication, time booking refers only to direct workers.

(b) Methods of Time Recording

- ***Time Spent in Factory (Attendance Time)***

  Register

  Here, the workers simply sign a register, recording their arrival time. The timekeeper may draw a line after the name of the last worker to sign on by the appointed starting time, so that the names of latecomers can be seen at a glance. This method requires considerable supervision and is only suitable with small numbers of staff.

  Mechanical Time Recorders

  Where there is a large number of employees, mechanised time-recording apparatus can be used to advantage. There are many types of machine available.

  Computerised Time Recorders

  This type of time recording system is directly linked to a computer. Each employee is issued with a card or badge, with personal data encoded into a magnetic strip, which is "swiped" through a reader at the beginning and end of the day. Data is sent direct to the computer system which can be used to produce an instantaneous attendance record and calculate wages. There may also be links with the costing system in order to provide accurate labour costing data.

- ***Time Spent on Cost Units (Job Time)***

  In order to allocate labour costs to particular cost units, it is necessary to establish the time spent by employees on those cost units. The records to enable this to be carried out are best maintained by means of **time clocks** and **job cards**.

  Job cards are used to ensure that time spent on a job or cost unit is properly evaluated and charged against that particular unit of cost. The type of industry and organisation will have a great influence on the kind of job card used and the procedure followed, but the routine described below will serve to illustrate the method.

  The production control department, through the foreman, allocates a job to an employee, and the foreman issues to that employee his or her appropriate card. The employee reports to the timekeeper, who "clocks on" the time of commencement of the job and returns the card to the worker. When the worker completes the job, he or she reports to the foreman, who enters the details of good and scrap work and initials the card. It is then taken by the worker to the timekeeper, who "clocks off" the card.

  The card is then forwarded to the wages office for calculation and extension. The job cards associated with each employee are gathered together each week to provide the figure of gross earnings for the week. The job cards are subsequently collated by job number, so that the total wages cost for each cost unit is established and charged to the job.

It is of prime importance that the **attendance and job times be reconciled** at the end of each week. The difference between the total attendance time and job time is clearly a loss to the organisation in the form of idle time. This is usually regarded as an **overhead** and is dealt with as such in the costing routine.

Methods of Remuneration

The two main methods of remuneration of labour are payment by **time of attendance** and payment by **results**.

(a) Payment by Time of Attendance

The great drawback which exists under this method is that there is no incentive to increase the level of production, and production can be maintained only by emphasis on supervision. There are certain types of work in which it is satisfactory to pay by time methods and these may be summarised as follows:

- **Executive** and **management** posts.
- Where the application of **skill and care** is a basic requirement for the proper completion of the job.
- Where **no satisfactory incentive scheme** can be applied – e.g. security men.
- Where **trainees** are employed.

There is also the high day-rate scheme, advocated in the USA by Henry Ford. The idea is that high rates are paid, but **strict performance targets** are set. The aim is to attract the best workers – those who have confidence in their ability to meet the targets.

(b) Payment by Results

- ***Piece-Work Schemes***

  Under these schemes, the operative is paid a certain rate for each unit he or she produces. This rate is arrived at after assessing (using work study methods) the time which should be taken to produce one unit. The aim of a piece-work scheme is, of course, to give the worker an incentive to increase production.

  Strict supervision is needed, otherwise quality may be sacrificed for quantity. Also, employees may tend to slacken once they realise that they have reached a certain level of earnings, e.g. the level at which they start to pay tax.

  This latter difficulty can be overcome to some extent by the use of **differential piece rates**, whereby the rate per unit is increased once a certain minimum output has been achieved. An example would be payment of £1 per unit for the first 10 units produced each day, and £1.50 for each additional unit produced.

- ***Individual Premium Bonus Scheme***

  You should note that, when payment is by time of attendance, the employer receives all the benefit from increased production; under piece-work schemes, the employee receives all the benefit (though the employer has the incidental benefit associated with all payment by results schemes, namely that fixed costs per unit are reduced, because they are spread over a larger number of units).

The idea of premium bonus schemes is to establish a partnership between employer and employee, so that each benefits from the savings from increased production.

There are seven basic requirements of a premium bonus scheme:

(ii) The scheme should be **simple in operation** and capable of being easily understood by each employee.

(iii) There should be a sound basis for setting **production targets**.

(iv) There should be **good relations and liaison** between the rate-fixers and the employees' representatives.

(v) The targets set should be capable of being attained by an **average employee**.

(vi) There should be **no limit** to the additional earnings the workers are allowed to receive under the scheme.

(vii) Workers should not be penalised for circumstances **beyond their control**.

(viii) The calculation should be carried out quickly, to ensure **prompt payment of the bonus**.

- ***Profit-Sharing Schemes***

  Schemes of this type are becoming increasingly popular. The employee is given a share of the profits of the business, either in the form of a cash bonus or in shares in the company.

  The main disadvantage is that, as payment is **remote from the actual performance of tasks** (payment will take place only once or twice a year), the incentive element is not strong. In addition, workers may be rewarded for good results which have come about through no effort on their part, or be penalised for bad results which are not their fault, because the profit level may depend on good or bad management action.

  Particularly where shares are given, however, such schemes give employees an interest in the long-term prosperity of their company and may help to reduce labour turnover.

  Profit sharing is particularly suitable for management grades, whose work is such that they cannot be rewarded by any other type of incentive payment.

Treatment of Overtime

Treatment of overtime is subject to the following underlying principle: charge the cost to the cost unit **causing the expense**.

(a) Job Cost

Charge to **individual jobs** if the customer wishes the delivery date to be brought forward and overtime has to be worked to do so.

(b) General Overhead

This category of overhead account is charged with overtime if **general pressure of business** has caused occasional overtime working. It would be unfair to make an extra charge to those jobs which just happened to be done in the evening.

(c) Direct Labour Cost

On the other hand, if overtime is worked regularly and consistently because of a shortage of direct workers, it is really part of the **normal direct labour cost**, and should be treated accordingly. An average hourly rate would be calculated, based on the number of hours at standard rate and the number of hours at premium rates, and all jobs would be charged with labour at this average rate.

(d) Departmental Overhead

If inefficiency within a particular department has caused overtime working, then that **departmental overhead account** should be charged with the cost.

If overtime has been worked in Department B because of Department A's inefficiency, the cost of overtime in Department B should be charged to the departmental overhead of **Department A**.

Labour Turnover

(a) Measuring Turnover

The most common measure of labour turnover is:

$$\frac{\text{Number of leavers replaced}}{\text{Average workforce}} \times 100\%$$

Thus, if a reduction in the workforce was planned – e.g. by offering early retirement – the people retiring early would not come into the turnover statistics. In measuring labour turnover, management is concerned to **control the cost of having to replace leavers**.

(b) Cost of Turnover

The cost of labour turnover can be high. It includes the following:

- ***Personnel Department***

  Under this heading come all the costs associated with **recruitment**: advertising, interviewing, interviewees' expenses, etc.

- ***Training New Recruits and Losses Resulting***

  Every new recruit must have some training. **Training costs money** in the form of the time of another operator who has to show the new starter the job, or the time of a supervisor or training school. Even after training, the new starter will be unable for some time to do a full day's work equivalent to that of a skilled operator with years of experience. The result is that the machines used by the new recruit are underemployed, causing further loss.

  The new starter is also likely to cause more scrap and possibly break tools and equipment more readily than a skilled operator. He or she is more liable to accidents, causing further loss.

(c) Prevention and Cure

A certain amount of labour turnover is inevitable – employees die or retire – and is indeed desirable, because it gives younger staff opportunities for promotion. However, since labour turnover is costly, it should be controlled. Every effort should be made to find out why workers leave and to rectify any apparent defects in the company and its personnel policy.

- ***Reasons for High Turnover***

  Where labour turnover is high and workers are being regularly lost to other firms in the same locality, the following factors require careful consideration:

  (i) **Methods of wage remuneration** – for example, is skill being adequately rewarded? Does average remuneration compare well with other local firms? Can workers reach an adequate rate of earnings without a high proportion of overtime working?

  (ii) Have the employees confidence in the **future long-term prospects of employment** within the organisation? If not, can their fears be modified?

  (iii) Is there any antagonism on the part of the employees, as a result of **inefficient management**?

  (iv) Are there sufficient **general incentives** to encourage employees to stay within the organisation – e.g. long service awards, pensions and housing incentives, canteen facilities, joint consultation procedures, sports and health care facilities, etc.?

- ***Potential Remedies***

  Personnel Department

  If recruitment procedures are good, labour turnover will be reduced because the right people will be given the right jobs. The personnel department can also help reduce labour turnover by developing and maintaining good employee/employer relations. Joint consultation may be developed. Clearly wage rates will be an important issue, as will opportunities for training and promotion.

  General Welfare

  Good employee/employer relations may be developed by the personnel department, but certain services will also go a long way towards maintaining such relationships and improving morale. The most important of these include the provision of sports and health facilities, e.g. sports field, tennis court, gym, private health insurance cover, etc.; canteen facilities with, possibly, subsidised meals; adequate first aid facilities with possibly a medical centre run by a doctor (depending on the size of the firm); a pension scheme and housing/mortgage subsidies – a very powerful factor in reducing labour turnover among employees over 30 years of age. Part of the expense of providing these facilities must be set against the cost of labour turnover, although some of these services will also tend to reduce absenteeism and sickness.

C. DECISION MAKING AND DIRECT COSTS

Understanding exactly what material and labour costs are and how they can be controlled is an integral part of the decision-making process. Once it is recognised, for instance, that overtime is likely to be required in the near future because the volume of work is forecast to rise, management can make the decision to employ more direct labour. Much will depend on the level of capacity at which the firm operates; if spare capacity is available within the workforce, it is advisable to consider whether there is sufficient flexibility to spread the workload, so avoiding the need for additional employees or perhaps even overtime.

Similarly with material costs; as an example, more expensive materials should be of better quality than the cheaper alternatives and therefore produce less wastage. The trade-off between higher cost with lower wastage and lower cost with higher wastage should be understood and the appropriate policy decision taken.

D. OVERHEAD AND OVERHEAD COST

What is "Overhead Cost"?

Overhead cost is defined in the CIMA Terminology as:

> *"The total cost of indirect materials, indirect labour and indirect expenses."*

This means those items of material, labour or expenses which, because of their general nature, **cannot be charged direct to a particular job or process**, but have to be spread in some way over various jobs or processes.

Identification of Overheads

In considering what is a direct charge and what is an indirect charge – i.e. overhead – regard must be paid to the type of industry, the method of production, and the particular organisation of the firm concerned. For instance, in a general machine shop making a variety of products, the foreman's wages would be an indirect or overhead charge, as there is no obvious method of identifying the cost of the foreman's wages with a particular job; but on a building site the foreman's wages would be a direct expense, as they can relate only **to the contract in hand**.

Problem of Overheads for the Modern Manager

Dealing with overhead expense is perhaps one of the most important problems facing the cost accountant today. The spread of mechanisation and automation has resulted in direct labour becoming an increasingly small proportion of total cost, and overhead expenses have become very much larger.

Classifying Overheads

There are three main **functional classifications** of overheads:

- **Production** overheads
- **Administration** overheads
- **Selling and distribution** overheads.

These are obviously associated with the three main functions of the business organisation and, as a first step, we should attempt to classify overhead expenditure into the appropriate categories. Clearly, there are certain items of cost which appertain to all three – such as electricity, rent and rates – and it will be necessary to break these individual charges down to the shares appropriate to the main functional headings.

(a) Production Overheads

Before any business can start producing goods or providing a service, it must have a **building** – which has to be heated, lit, ventilated and provided with power. The building must be kept clean and will need repair and redecoration from time to time and, in addition, rent and rates will have to be paid. The products will have to be designed, and production must be planned, supervised and checked.

Records have to be kept, wages calculated, and materials must be stored and conveyed from point to point within the building.

These functions, and others, are not directly concerned with actual production, but are none the less essential and may be looked upon as services to the actual job of production. It is the costs of providing these services which constitute the production overheads.

(b) Administration Overheads

We have already stated that the type of industry will affect the levels of each of the different types of overhead. Manufacturing industry will incur a greater proportion of production overhead than administration overhead, whereas, in general, it will be the other way round for service industries.

Examples of administration overhead are the salaries of those people in the offices not directly concerned with production, heating and lighting of the offices, stationery, office repairs and so on.

Taking our architects' practice that we looked at in the previous study unit, the costs of the salaries of the architects specifically engaged on contract work for customers would be classed as a direct labour cost to the particular contract concerned. In addition, associated costs such as specified computer software and perhaps allocation of rent, rates, electricity, etc. would all be classed as production overhead. The costs of a secretary and any other non-direct office costs would be classed as administration overhead.

The distinctions between each will probably be unique to each organisation in the way it is set up and operated. Remember that these allocations are to provide costing information for management and (as we will see in the next three study units) stock values.

(c) Selling and Distribution Overheads

The dividing line between production overheads and selling and distribution overheads comes when the finished goods are delivered to the finished goods store. Examples of selling and distribution overheads include salespeople's salaries, commission and expenses, advertising, warehouse charges and so on. In addition, carriage, packing and despatch costs may sometimes also be included.

Study Unit 4

Absorption Costing

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INTRODUCTION

In this study unit and the next two, we shall be looking at the different methods used to add overheads to the direct costs of production. The first method, absorption costing, is the most criticised and is becoming increasingly less used, although it is still an important topic to be able to understand and critically assess.

A. DEFINITION AND MECHANICS OF ABSORPTION COSTING

What we are attempting, in absorption costing, as well as marginal costing and activity-based costing – which will be examined later – is to obtain an accurate cost of producing an item, which will include the overheads that have been incurred in its production, together with labour and materials.

Definition

The CIMA Terminology describes absorption costing as:

> *"A principle whereby fixed as well as variable costs are allotted to cost units and total overheads are absorbed according to activity level."*

The same text also supplies a diagram (Figure 4.1.)which should help to bring together much of what we have looked at so far.

The diagram illustrates how the total cost of an item is built up using direct costs (also known as "prime cost"), absorbed production overhead and what might be termed "other" overhead comprising the cost of marketing, administration and Research and Development functions. It is the method of absorbing production overhead with which we shall be primarily concerned here.

Absorption costing comprises three stages:

- cost allocation;
- cost apportionment;
- cost absorption.

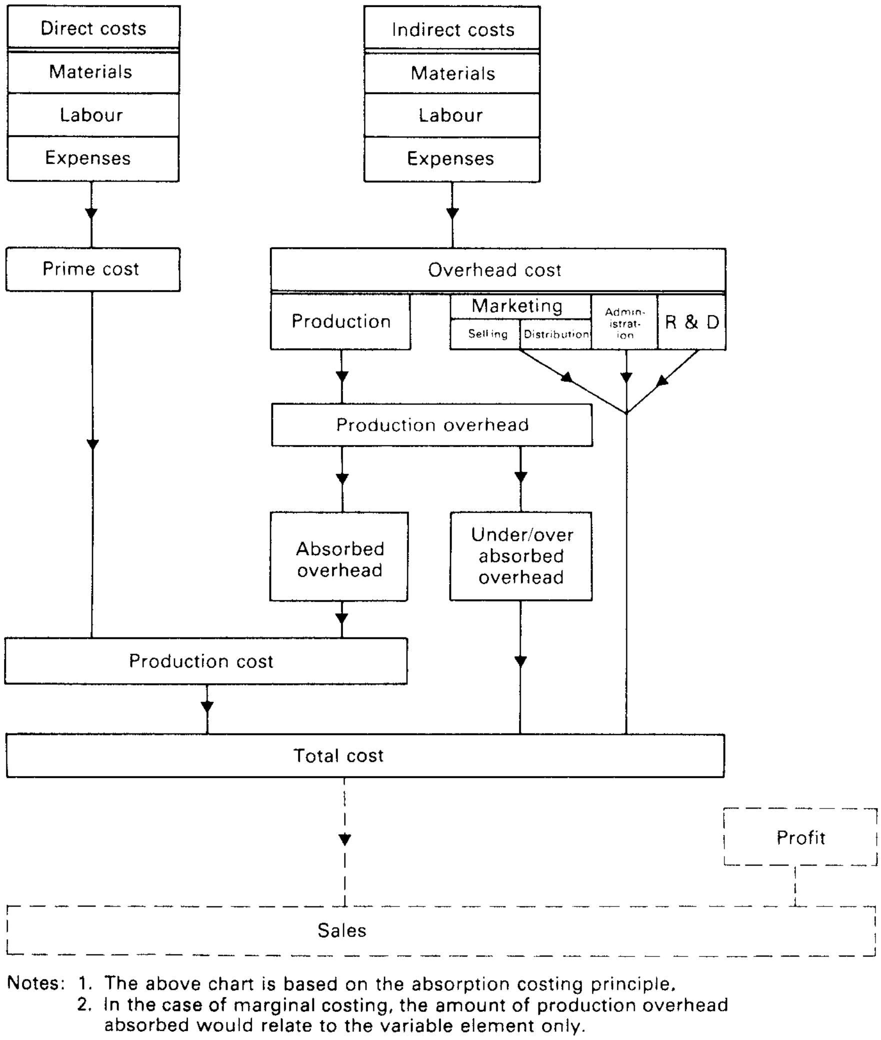

Figure 4.1: Elements of Cost

B. COST ALLOCATION

The CIMA Terminology defines cost allocation as:

> *"The charging of discrete identifiable items of cost to cost centres or cost units."*

In other words, where the overhead can be directly identified, it can be allocated straight to the cost unit or cost centre. Referring to Figure 4.1, such costs would be classified as direct cost expenses and would include such items as a foreman's wages for a production department, or the electricity charge for a production department if they are on a separate meter. Note that if the foreman covered several different production departments or the electricity bill could not be separately identified then such costs would need to be apportioned.

C. COST APPORTIONMENT

Cost apportionment is defined as:

> *"The division of costs amongst two or more cost centres in proportion to the estimated benefit received, using a proxy, e.g. square feet."*

Referring once again to Figure 4.1, it is the unallocated production overhead that will need to be apportioned. We have already seen that this would include block items such as electricity, but it would also comprise items such as the total factory rent, depreciation of the plant and machinery and so on.

Cost centres may consist of one of the following:

- production departments
- production area service departments
- administration, selling/distribution or R and D departments
- overhead cost centres.

Each cost centre will have the appropriate costs charged to it. Thus, direct materials and labour will be charged to the production department together with allocatable overheads. Overhead to be apportioned, which remember will form part of the prime cost (refer again to Figure 4.1 if you are not sure), will be charged to the production area service departments.

Methods of Apportionment

The production overhead so coded will then need to be apportioned to the production department cost centres. There are a number of ways of achieving this distribution as follows:

(a) Capital Value of Cost Centre

Where overhead cost is increased by reference to the **capital value** of the cost centre, it should be apportioned in the same way, e.g. fire insurance premium charged by reference to capital value.

(b) Cost Centre Labour Cost

Where the overhead cost depends on the **extent of labour cost** of the centre – such as in the case of employers' liability insurance premiums – this should also form the basis for the apportionment of the premium paid.

(c) Cost Centre Area

Where overhead cost depends on the **floor area**, it should be apportioned in the same way, e.g. rent and rates.

(d) Cost Centre Cubic Capacity

Where overhead cost is incurred **in phase with cubic capacity** – e.g. heating – it should be apportioned on this basis.

(e) Cost Centre Employees

The overhead cost of providing a canteen service is generally proportional to the numbers employed, so it is reasonable to apportion it by reference to the **numbers employed** at each cost centre.

(f) Technical Estimate

The chief engineer of a factory should give estimates as to the incidence of the overhead cost of certain expenses between the various cost centres of the factory:

- ***Light***

  The wattage used in each department can be calculated, and the cost of lighting apportioned to each cost centre accordingly.

- ***Power***

  The horsepower of machines in each cost centre can be established, and the cost of power apportioned on this basis.

(g) Proportionate to Materials Issued

The overhead expenses of operating the stores department, and "normal" stores losses, may be apportioned by this method, measuring materials by value, weight, or volume, as appropriate.

(h) Proportionate to Production Hours

There are many items of overhead expenditure which usually can be apportioned on this basis, although the figures are usually available only where a fairly comprehensive costing system is in operation. Either labour hours or machine hours may be used. Items which may be apportioned on this basis are:

- overtime wages (where not allocated direct)
- machine maintenance (where not chargeable direct).

Specimen Overhead Allotment Calculation (Including Service Activities)

A company has 2 production departments, X and Y, and 3 service departments – stores, maintenance and production control.

The following data are available:

	Stores	Mainten-ance	Prod'n Control	X	Y	Total
Areas in sq. m	300	400	100	3,000	4,200	8,000
No. of employees	4	12	30	200	300	546
Value of equipment (£000)	-	8	-	20	12	40
Electricity (000 units)	-	20	-	320	210	550
No. of extraction points	1	2	-	14	23	40
Indirect material cost (£)	11	25	44	31	63	174
Indirect labour cost (£)	287	671	1,660	1,040	1,805	5,463

Other overhead costs for the year are as follows:

	£
Rent	800
Factory administration costs	2,184
Machine depreciation	440
Power	550
Heat and light	80
Machine insurance	40
Fumes extraction plant	120

You are required to prepare an **overhead analysis sheet** showing the basis for apportionments made. Figure 4.2 shows the form in which the figures should be displayed.

The figures for indirect material and indirect labour have been pre-allocated obviously because it is possible to identify exactly how much has been incurred by each respective department.

So that you can understand the calculations for each of the items, we shall go through the calculations for one of them. The rent will be based on each department's square footage as a percentage of the total square footage. Thus for the stores department this will be:

$$\frac{300}{8{,}000} \times £800 = £30$$

and so on for all the other departments until the total rent of £800 has been allocated.

	Apportionment Basis	Total Cost £	Stores £	Maintenance £	Production Control £	X £	Y £
Rent	Area	900	30	40	10	300	420
Indirect material	Allocation	174	11	25	44	31	63
Indirect labour	Allocation	5,463	287	671	1,660	1,040	1,805
Factory admin.	No. of employees	2,184	16	48	120	800	1,200
Machine depreciation	Value	440	–	88	–	220	132
Power	Electricity used	550	–	20	–	320	210
Heat and light	Area	80	3	4	1	30	42
Machine insurance	Value	40	–	8	–	20	12
Fumes extraction plant	No. of extraction points	120	3	6	–	42	69
Total		**9,851**	**350**	**910**	**1,835**	**2,803**	**3,953**

Figure 4.2: Overhead analysis sheet

We have now arrived at an estimate of the overhead appropriate to each department or cost centre. However, we really need to express all overhead costs as being appropriate to one or other of the two **production departments**, so that we can include in the **price of the products** an element to cover overhead – for it is only in this way that costs incurred will be recovered. Although costs have been incurred **by** the service departments, they have really in the end been incurred **for** production departments. We need to associate **all** costs with a production department, so that we can relate these costs to cost units which pass through the production departments.

So the next step is to **reapportion the costs of the service departments** (see Figure 4.3). The methods employed are similar to those used in the original apportionment.

Additional data is provided: the total number of material requisitions was 1,750, of which 175 were for the maintenance department, 1,000 for Department X and 575 for Department Y. This data will be used to apportion the costs of the stores department to these three departments. Maintenance costs will be directly allocated to production control and Departments X and Y. (In practice, a record may be kept of the number of maintenance hours needed in each department, to provide data for cost apportionment.) Production control costs will be apportioned between X and Y, according to the number of employees in these departments (already given).

Note that when departmental costs are reapportioned, the cost is **credited to that department**.

Item	**Apportionment Basis**	**Stores** £	**Mainten-ance** £	**Prod'n Control** £	**X** £	**Y** £
Costs b/f		350	910	1,835	2,803	3,953
Stores Dept costs reapportioned	No. of requisitions	–350	35	-	200	115
Maintenance Dept. costs allocated	Allocation	-	–945	126	263	556
Production Control costs reapportioned	No. of employees	-	-	–1,961	784	1,177
Totals		**Nil**	**Nil**	**Nil**	**4,050**	**5,801**

Figure 4.3: Reapportionment of Service Department Costs

Having completed the reapportionment, you will see that the total of overhead now attributed to Departments X and Y is, of course, equal to the **original total of overhead**.

Having apportioned the indirect production overhead, the important part is to analyse and critically appraise the figures provided. The total costs for Departments X and Y can now be apportioned over the number of cost units to provide a cost per unit.

For the purpose of our example, let us assume that Department X has produced 1,000 small print rollers and Department Y 4,000 canisters. The direct cost per unit has been calculated as £9.50 for the rollers and £4.50 for the canisters, so we are now in a position to compare the total cost against that originally estimated.

	Department X £	Department Y £
Direct cost per unit	9.50	4.05
Allocated overhead per unit (4,050/1,000; 5,801/4,000)	4.50	1.45
	13.55	5.95
Standard cost	12.00	6.00
Variance	(1.55)	0.05

The variance can be analysed in a number of ways and standard costing and its associated variance analysis will be covered in more detail later. In the case of Department X it may be deemed necessary to investigate why each unit has cost £1.55 more than expected. The important thing here is that we have ascertained the cost per unit and have then been able to compare it with the cost that was expected.

In this example we have assumed that the allocated overhead is simply divided by the number of units of production. This is possible in instances where identical products are manufactured but in practice it is not that simple. We shall now go on to look at the various ways in which the overhead is **absorbed** into each cost unit.

D. OVERHEAD ABSORPTION

The CIMA definition of overhead absorption is:

> *"The charging of overhead to cost units by means of rates separately calculated for each cost centre."*

In other words, the amount of overhead absorbed by a product means the proportion of the total overhead which, we estimate, is **appropriate to that product**.

Overhead costs may be **absorbed** into product costs in a variety of ways, but the two principal methods are:

- by the use of **percentages**;
- by **rates based on time**.

Percentage Rates

The use of percentages is generally less satisfactory than rates based on time. An overall or **blanket** percentage rate may be calculated by relating all factory overhead to total labour costs, and applying this single percentage rate throughout the factory. This can give rise to anomalies, particularly where the incidence of overheads varies from one cost centre to another. If percentages **are** to be used, a better approach is to apply a separate percentage rate for each cost centre, based on the overheads incurred and labour cost **for each cost centre**.

Absorption on Basis of Time

If you have had any experience of costing, you will have concluded that much overhead expenditure is, above all else, subject to the **time factor** in its relation to output. If one article takes twice as long to go through the factory as another, it should attract to itself twice the charge for lighting the factory as the other product; this is only one example which can be multiplied many times from a manager's own experience. It is generally true, therefore, that by far the most valuable method of apportioning overheads is on a time basis, and this is usually of one or two kinds – a **rate per direct labour hour** or a **rate per machine hour**, depending on the degree of mechanisation within the particular cost centre.

Occasionally, a combination of both of these will be in operation, and a **composite rate per production hour** used.

(a) Direct Labour Hour Rate

Where this system is used, the number of hours of direct labour worked in a production centre is divided into the total figure shown in the expense summary for that production centre for the corresponding period. The resultant figure gives the **overhead cost per direct labour hour**.

This is a very satisfactory method, particularly where a production centre uses little elaborate or expensive machinery, and when it may reasonably be said that every hour of direct labour incurs the same amount of expense. You must remember, however, that separate direct labour hour rates should be calculated for **each production centre** and that holidays should be excluded, as should overtime hours (except when this is a regularly recurring feature).

A "rate per labour hour" is defined as "an actual or predetermined rate of cost apportionment or overhead absorption, which is calculated by dividing the cost to be apportioned (or absorbed) by the labour hours expended or expected to be expended".

The advantages of this system are outlined below:

- The result is not made unworkable by use of both skilled and unskilled labour.
- Proper provision is made to deal with fast and slow workers who are paid piece-rates.
- The figure of labour hours is a more useful guide to the management than the value of wages paid, because fluctuations due to varying overtime rates and wage increases are avoided.

The formula for calculating a rate per direct labour hour is:

$$\frac{\text{Overheads for the period}}{\text{Direct labour-hours worked or to be worked in the period}} = \text{Rate per direct labour-hour}$$

(b) Rate per Machine Hour

Where machinery rather than labour is the dominant feature of a production centre, a rate of overhead per hour of machine time should be substituted for a rate per direct labour hour.

To find this rate per machine hour, it is necessary to estimate the **number of hours of operation of the machine or machines in the cost centre during the period under consideration**. Allowance must be made for idle time and for cleaning and setting-up time. The total expense is then divided by the number of working machine hours.

(c) Specimen Rate per Machine Hour Calculation

Let us return to our earlier example of overhead allotment. After the service departments' costs had been reapportioned, the costs attributed to the production departments X and Y were £4,050 and £5,801 respectively.

Now suppose that Department X had 5 identical machines working 162 hours each during the period under consideration. Department Y is not automated, and has 20 direct workers, each working 160 hours during the period.

The total number of machine hours worked in Department X is 5 × 162 = 810 hours. Therefore, the rate per machine hour is £4,050 ÷ 810 = £5 per machine hour.

The total number of direct labour hours worked in Department Y is 20 × 160 = 3,200 hours. Therefore, the rate per labour hour is £5,801 ÷ 3,200 = £1.81 per direct labour hour.

Suppose that the manufacture of a print roller takes 4 machine hours in Department X. It is then passed to Department Y for hand finishing, which takes 6 hours. The amount of overhead absorbed (incurred) by this article is then:

4 × £5 (Dept X) + 6 × £1.81 (Dept Y) = £30.86

(Note that earlier we assumed that Department Y actually manufactured an entirely different product rather than carrying out a further process. In reality either situation could and does occur.)

In determining the total cost of the article, this sum would be added to the cost of the direct materials, direct labour and direct expenses incurred.

In this calculation above, only one hourly rate has been calculated for each department. In practice, fixed and variable overhead, if possible, will be kept separate, and a **separate absorption rate** will be calculated for each.

When the machines in a department are not identical (as they were in our specimen calculation) it is necessary to calculate the rate for each machine separately. The following principles may be generally applied:

- Some expenditure can be **directly** allocated to the particular machine – e.g. power, cost of repairs, depreciation.
- Overhead chargeable to the production centre in which the machine is located, and not to the individual machine, e.g. rent, rates, heating, is **apportioned** on the basis of area occupied.

(d) Specimen Machine-Hour Absorption Rate Calculation

Using the data below, you are required to calculate a machine-hour absorption rate for multi-drilling machine No. 5.

Relating Specifically to Machine No. 5

Original cost:	£13,300
Estimated life span:	10 years
Estimated scrap value after 10 years:	£300
Floor space occupied:	250 square metres
Number of operators:	2
Estimated running hours:	1,800 per annum
Estimated cost of repairs:	£240 per annum
Estimated cost of power:	£1,000 per annum

Relating to Department in which Machine No. 5 is Situated

Floor area:	5,000 square metres
No. of operators:	60
Rent:	£4,400 per annum
Supervision:	£3,600 per annum

In addition to the costs specifically relating to machine No. 5, the following apportioned costs must be taken into account:

- **Rent** – on the basis of floor area occupied.
- **Supervision** – on the basis of number of operators for machine No. 5 compared with the whole department.

Therefore, the total costs appropriate to machine No. 5 are as follows:

	£ per annum
Depreciation: (£13,300 – £300) ÷ 10	1,300
Rent ($\frac{1}{20}$ of department's cost) (250 out of 5,000)	220
Supervision ($\frac{1}{30}$ of department's cost) (2 out of 60)	120
Repairs	240
Power	1,000
	£2,880

Therefore, the rate per machine hour is $\frac{2{,}880}{1{,}800}$ = £1.60 per machine hour.

Predetermined Absorption Rates

In the examples considered so far, we have been dealing with a **known total of overhead** which was allocated or apportioned to cost centres and, hence, to cost units. In practice, of course, costs are being incurred while production is taking place, and total costs are not known until the end of the period. However, management needs timely information on product costs as they are being incurred. To overcome this problem, **predetermined** overhead rates are used. These are based on estimated overheads and estimated production levels. Each job then absorbs overhead at a predetermined rate.

(a) At the end of each period, it is necessary to compare the overhead which has been absorbed with that **actually incurred**. Almost certainly, there will be differences. Overhead will have been over-absorbed if the production level was greater than anticipated, or if overhead costs were lower than anticipated. Conversely, overhead will have been under-absorbed if the production level was lower than anticipated or overhead costs were greater.

(b) The overhead over- or under-absorbed each month is transferred to an **overhead adjustment account**, and at the end of the year the net amount over- or under-absorbed is transferred to the profit and loss account. This method is preferable to the alternative of carrying forward a balance on the overhead account each month, although this alternative method **is** acceptable if the under- or over-absorption is caused purely by seasonal fluctuations where an average annual rate of overhead absorption is in use. In this case, there will be under-absorption in some periods and over-absorption in others, because of the seasonal factors, but the net effect over a year will be nil. Nevertheless, since a cost accountant will rarely be in a position to say that **all** under- or over-absorption is due to seasonal factors, it is still considered preferable to operate an overhead adjustment account.

Specimen Calculation Using Predetermined Absorption Rates

In a period in which 1,600 direct labour hours are expected to be worked, fixed overheads are expected to be £20,000. In fact, only 1,550 direct labour hours are worked and the actual overhead incurred is £19,750.

The predetermined rate for absorption of overhead is £12.50 per direct labour hour (£20,000 ÷ 1,600). Thus, for instance, a job which took 20 hours to complete would absorb £250 fixed overhead.

Because 1,550 direct labour hours are worked, the amount of overhead which has been absorbed by the end of the period, using the predetermined absorption rate, is 1,550 × £12.50 = £19,375.

Comparing this with the **actual** overhead incurred, we see that overhead has been under-absorbed by £375.

Extracts from the relevant accounts are given below.

Overhead Control

	£		£
Incurred	19,750	Work-in-progress – absorbed overhead	19,375
		Overhead adjustment – under-absorbed overhead	375
	19,750		19,750

Work-in-Progress

	£		£
Direct material		Transferred to finished goods stock	19,375
Direct labour			
Overhead absorbed	19,375		
	19,375		19,375

Overhead Adjustment

	£		£
Overhead control – under-absorbed overhead	375	Profit and loss	375
	375		375

E. TREATMENT OF ADMINISTRATION AND SELLING AND DISTRIBUTION OVERHEAD

We have already seen that items of production overhead can be directly allocated or apportioned. Generally, administration and selling and distribution overhead can either be apportioned or written straight off to the profit and loss account. Whichever method is used, the usual requirements of a common sense, consistent approach are needed.

Administration Overhead

It is not generally worthwhile to attempt to be too scientific in apportioning administration costs to products. For pricing purposes, the inclusion of an **agreed percentage on production costs** will generally be adequate. For other purposes there is no need to absorb administration costs into production costs – instead they can be treated as period costs to be written off in the profit and loss account.

Selling and Distribution Overhead

(a) Variable Elements

Some elements of selling and distribution overheads vary directly with the quantities sold – for instance, commission paid to a salesperson on a unit basis. Such items can be charged directly to the product concerned in addition to the production cost.

(b) Fixed Elements

Other elements are incurred whether products are sold or not – for instance rent of showrooms, salaries of salespeople. Such items may be treated as period costs and written off in the profit and loss account; or they may be absorbed in one of three ways, as shown below.

- ***Percentage on Sales Value***

  Selling overhead for year: £250,000

  Estimated sales value for year: £2,500,000

  $$\text{Absorption rate} = \frac{\text{Cost}}{\text{Activity}} \times 100$$

  $$= \frac{£250{,}000}{£2{,}500{,}000} \times 100 \text{ or } 10\%$$

  In this case we add 10% of the sales value of the cost unit to the cost to cover selling overheads.

  This method is useful when prices are **standardised** and the proportions of each type of article sold are **constant**

- ***Rate per Article***

  Selling overheads for year: £250,000

  No. of articles to be produced: 1,000,000

  $$\text{Absorption rate} = \frac{\text{Cost}}{\text{Activity}} = \frac{£250{,}000}{£1{,}000{,}000}$$

  or 25p per article

For each article produced, 25p is added to the cost.

This method is particularly applicable where a **restricted range of articles** is produced, but it can be used for an extended range by evaluating different sizes, using a points system.

- ***Percentage of Production Costs***

  Selling overhead for year: £250,000

  Estimated production cost of sales for year: £2,000,000

  $$\text{Absorption rate} = \frac{\text{Cost}}{\text{Activity}} \times 100 = \frac{£250{,}000}{£1{,}000{,}000} \times 100$$

  or 12½%

  12½% of the production cost of each unit is calculated and added to that cost.

  Care must be taken in applying this method. For instance, suppose a company makes two products, A and B. A costs twice as much as B to produce. Therefore a percentage on production-cost basis would charge A with twice as much selling and distribution overhead as B. But suppose there is a ready market for product A, which means that the firm has no need to advertise it, while with product B the firm is in competition with others and spends £5,000 p.a. on advertising B. Then it is clearly incorrect to charge A with twice as much overhead as B! (In fact, the cost of advertising B should have been charged directly to Product B.)

  This method is, however, acceptable if the costs involved are small, or if there is a limited range of products and those costs which clearly do **not** vary with cost of production (as in the above example) can be charged direct.

F. USES OF ABSORPTION COSTING

The arguments put forward for the use of absorption costing are as follows.

Stock Valuations

These are integral to the financial accounts not only for providing a value for the closing stock in the balance sheet but also for determining the cost of sales figure in the profit and loss account.

The importance of this lies in the fact that stock sold in an accounting period will usually consist of some items held in stock at the beginning of the period and some produced during the period. The calculation of the cost of sales figure to use is therefore:

	Value of opening stock
plus	Cost of goods produced
minus	Value of closing stock

Thus in those instances where financial and costing systems are integrated, the method used to value stock is extremely important.

Pricing

This is covered in greater detail in later study units, but it is useful in the context of absorption costing to mention that one method of arriving at a selling price is to add a percentage to the cost of producing the item. This is known as "cost plus pricing" and ensures that all the costs of production are covered and some of the sales value is left over to be put towards the company's selling and administration overhead and providing a profit.

As an example, if a company's cost of producing a particular item is £4 and a pricing system of "cost plus 25%" operates, then the selling value will be £5. This covers the cost of production and provides £1 towards overhead and profit.

Profit Comparison

By apportioning overhead to production it is possible to compare how profitable different items are. This occurs particularly with those items that take a disproportionate overhead but have a relatively low cost in terms of materials and labour. In this instance if we were to compare items merely on prime cost we could make the wrong production decision, particularly where we have limited resources.

As an example, consider the following:

Product	**Prime Cost**	**Apportioned Overhead**	**Full Cost**	**Selling Price**
	£	£	£	£
Wooden garden seat A	65	15	80	100
Wooden garden seat B	55	30	85	100

Assume that seat B uses far less materials but is more complex to manufacture and therefore takes more overhead because the company uses a predetermined absorption rate based on labour hours. As you can see, if we take prime cost only, it appears that seat B is far better because it makes a profit before overhead of £45 (£100 – £55) as opposed to seat A which makes £35. If we then use this information to allocate our scarce resources (which could be labour, materials, factory space, etc.) then we could end up producing more of seat B which only makes £15 after overhead is apportioned.

One criticism against this type of approach could be that it is unrealistic to make such decisions based on an arbitrary allocation of overhead, particularly when a blanket predetermined absorption rate is used.

In practice the information would be better used to price seat B at £105, so making the same profit as seat A. This presupposes, of course, that people are willing to pay the increased price.

SUMMARY

Absorption costing is increasingly seen as less relevant when compared with the newer approaches of marginal and activity-based costing – which will be covered in the next two study units. Despite this, it is still widely used in industry and there is a good chance that you will meet it at some stage, particularly in connection with traditional manufacturing industry.

The concept of absorption costing has many critics and, as we shall see in the next study unit on marginal costing, incorrect decisions can occur as a result of misinterpretation of the results it produces. In that case, you may ask, why does it continue to be used? One reason is cost; many older, particularly smaller, firms cannot afford to implement a completely new system. Another reason is that the benefits of introducing a new system are seen as negligible, especially when the absorption costing method is considered to provide sufficiently accurate information on which to base managerial decisions.

Study Unit 5

Marginal Costing

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INTRODUCTION

Marginal costing is a very important subject area. The topic often features in examination questions and a thorough grasp of this area of costing will provide you with valuable techniques for resolving many different types of business problem.

In this study unit we shall consider the principles of marginal costing and examine how this and the previous technique – absorption costing – produce different results from the same information. We shall also attempt to determine the conditions under which each method is considered more appropriate.

A. DEFINITIONS OF MARGINAL COSTING AND CONTRIBUTION

The CIMA Official Terminology defines marginal costing as:

> *"A principle whereby variable costs are charged to cost units and the fixed cost attributable to the relevant period is written off in full against the contribution for that period."*

In order for you to understand fully the above, it is necessary at this point to define contribution:

"The difference between sales value and the variable cost of those sales, expressed either in absolute terms or as a contribution per unit."

This is a central term in marginal costing, when the contribution per unit is expressed as the difference between its selling price and its marginal cost. In turn this is then often related to a key or limiting factor to give a sum required to cover fixed overhead and profit, such as contribution per machine hour, per direct labour hour or per kilo of scarce raw material.

You should recall from your earlier studies that costs can be simply classified as fixed or variable. Absorption costing recognises some elements of fixed cost as part of the cost of a unit of output, whereas marginal costing only takes variable costs into consideration. Fixed costs are written off in the period in which they are incurred, regardless of output.

Variable costs include direct costs as before (i.e. direct labour, direct materials and direct expenses) plus variable production overhead. In addition, the variable costs of administration, sales and distribution may also be included.

The concept of contribution should also be explained more fully at this point. As marginal costing only takes variable costs into account on a per unit basis the contribution is sales value less the calculated variable cost. In other words it is the remainder that is the contribution towards covering the fixed costs and making a profit.

You may also meet the term "variable costing" which is merely another name for marginal costing.

Marginal Costing Example

An example of marginal costing should prove useful at this point to aid in your understanding of the principles involved. We shall look at profit calculations using both marginal and absorption costing later.

Beanland Ltd make a single product, the "Beany", which sells for £15 per unit. Opening stock is zero and 10,000 units are produced in the period. Variable costs (labour, material and expenses) are £10 per unit and fixed costs are £37,500.

Calculate the profits at sales volumes of 5,000, 7,500 and 10,000 units.

	5,000 Units		**7,500 Units**		**10,000 Units**	
	£	£	£	£	£	£
Sales		75,000		112,500		150,000
Opening Stock	–		–		–	
Variable Production Cost	100,000		100,000		100,000	
Closing Stock	(50,000)		(25,000)		–	
Variable Cost of Sales		50,000		75,000		100,000
Contribution		25,000		37,500		50,000
Fixed Costs		37,500		37,500		37,500
Profit (Loss)		(12,500)				12,500

There are several point to note from the above example.

- Closing stock is valued at variable production cost, i.e. £10 per unit; so at sales volumes of 5,000 units and production of 10,000 units, the closing stock value will therefore be 5,000 units × £10 = £50,000.
- Contribution per unit is constant so the more units that are sold the greater the contribution towards fixed cost and profit.
- Overall profits vary because fixed costs are written off in their entirety regardless of the level of sales achieved.

Contribution/Sales Ratio

It may be apparent from the previous example that there is a simple way of calculating expected contribution at various levels of sales once we know the contribution per unit. Thus, with a sales value of £15 and variable costs per unit of £10 the contribution per unit is £5. If, for example, we wish to know the expected level of profit for sales of 8,000 units, it is simply 8,000 × £5 = £40,000. By deducting the fixed costs we can arrive at the expected profit of £2,500.

The usefulness of this is that it not only gives a volume-related profit figure much more quickly, but also provides us with the level of sales needed to break even.

In the above example, for instance, the calculation would be:

$$\frac{\text{Fixed costs}}{\text{Contribution per unit}} = \text{Break-even sales}$$

$$\frac{\pounds 37{,}500}{\pounds 5} = 7{,}500$$

which incidentally was the figure that provided neither a profit nor a loss in the original calculations.

This is a useful decision-making tool and will be examined in more detail in the study unit on Cost – Volume – Profit Analysis.

B. MARGINAL VERSUS ABSORPTION COSTING

By now you should be aware of the fact that the fundamental difference between marginal and absorption costing is the treatment of fixed overheads.

Under marginal costing principles, fixed costs are written off in the period and closing stock is valued at variable cost only. With absorption costing, a share of fixed production cost is included in the value of closing stock.

An example showing how the two techniques produce different profits will be useful at this stage. Referring back to our earlier work on Beanland Ltd, the results using the absorption costing method would be as follows:

	5,000 Units		**7,500 Units**		**10,000 Units**	
	£	£	£	£	£	£
Sales		75,000		112,500		150,000
Opening Stock	–		–		–	
Variable Production Cost	100,000		100,000		100,000	
Fixed Production Cost	37,500		37,500		37,500	
Closing Stock	(68,750)		(34,375)		–	
		68,750		103,125		137,500
Profit (Loss)		6,250		9,375		12,500

Closing stocks are valued at variable plus fixed production cost, i.e. $\dfrac{£100{,}000 + £37{,}500}{10{,}000} = £13.75$.

The comparison of profits under the two techniques is therefore as follows:

Sales	**Absorption** £	**Marginal** £	**Difference** £
5,000 units	6,250	(12,500)	18,750
7,500 units	9,375	–	9,375
10,000 units	12,500	12,500	–

As you can see, there is quite a difference in the reported profits. This is due to the fact that, under absorption costing, more of the fixed cost is carried forward to a later period. In the case of sales of 5,000 units, for instance, the closing stock value has increased from £50,000 to £68,750 (an increase of £18,750 which equals the increase in profit of £18,750).

An alternative way of viewing this is to calculate the additional cost per unit multiplied by the number of units in stock (i.e. £13.75 – £10.00 × 5,000 = £18,750)

Where there is no change in stock levels, both techniques give the same profit figure as the cost of sales is exactly the same no matter how it is calculated.

Manufacturing for Profit

One of the major arguments put forward against absorption costing is that, because fixed costs are apportioned to production and therefore carried forward in closing stock, it is possible to increase production and thereby increase profit even if sales volumes are static or falling.

This is only a short-term measure though as the costs will still be offset against profit, albeit in a later accounting period. Using our earlier example once again, let us see what the effect is under absorption costing of increasing production whilst keeping sales volumes at the same level.

The management at Beanland Ltd decide that although there will be no increase in sales volume this year from the current potential levels of 5,000, 7,000 or 10,000 units, production will be increased to 15,000 units. All other figures are as before, i.e. sales value per unit is £15, variable costs are £10 per unit and fixed costs £37,500. The revised profitabilities under absorption costing would be:

	5,000 Units		**7,500 Units**		**10,000 Units**	
	£	£	£	£	£	£
Sales		75,000		112,500		150,000
Opening Stock	–		–		–	
Variable Production Cost	150,000		150,000		150,000	
Fixed Production Cost	37,500		37,500		37,500	
Closing Stock	(125,000)		(93,750)		(62,500)	
		62,500		93,750		125,000
Profit – production 15,000 units		12,500		18,750		25,000
Profit – production 10,000 units		6,250		9,375		12,500

In all cases the profit is increased because the fixed overhead is spread over more units. The increased units are carried forward as increased stock and therefore the fixed cost element is carried also. At production volumes of 15,000 units and sales volumes of 5,000 units for instance, fixed costs are absorbed at £2.50 per unit, which means that £25,000 of fixed costs will be carried forward (10,000 × £2.50). At production volumes of 10,000, fixed cost was absorbed at £3.75 per unit and therefore £18,750 was carried forward in closing stock (5,000 × £3.75). The increased level of fixed cost carried forward is therefore £25,000 – £18,750 = £6,250 – the increase in profit for the period at sales volume of 5,000 units.

Under marginal costing principles, the profit for the period is unchanged because only variable cost is being carried forward. To prove the point, at sales of 5,000 units the results are as follows:

Marginal Costing – Sales of 5,000 Units, Production of 15,000 Units

	£	£
Sales		75,000
Opening Stock	–	
Variable Cost	150,000	
Closing Stock	(100,000)	50,000
Contribution		25,000
Fixed Cost		37,500
Profit		(12,500)

which is the same loss that we calculated under production of 10,000 units.

This shows clearly how figures could be manipulated in the short term using absorption costing.

Long-Term Comparisons

Although, as we have just seen, absorption costing can be used to enhance short-term profitability, over the longer term both techniques will produce the same profitability. This is because the fixed cost element is the same amount under both – it is just that there is a timing differential whereby some may be carried forward in stock to be expensed in a later period.

To illustrate this, consider the position where we have two accounting periods, sales of 7,500 units in period 1 and 12,500 units in period 2. Sales values are £15 per unit and variable production costs £10 per unit. Production is 10,000 units per period and opening stock at the beginning of period 1 is zero. Fixed costs are £37,500 per period; we shall compare the position over the two periods using both absorption and marginal costing.

(a) Marginal Costing

	Period 1		**Period 2**		**Total**
	£	£	£	£	£
Sales		112,500		187,500	300,000
Opening Stock	–		25,000		
Production cost	100,000		100,000		
Closing stock	(25,000)		–		
		75,000		125,000	200,000
Contribution		37,500		62,500	100,000
Fixed cost		(37,500)		(37,500)	(75,000)
Profit/(Loss)		–		25,000	25,000

(b) Absorption Costing

	Period 1		Period 2		Total
	£	£	£	£	£
Sales		112,500		187,500	300,000
Opening Stock	–		34,375		
Production cost	137,500		137,500		
Closing stock	(34,375)		–		
		103,125		171,875	275,000
Profit/(Loss)		9,375		15,625	25,000

Both methods give the same overall profits because there is no opening stock at the beginning of period 1 and no closing stock at the end of period 2. The difference is therefore purely one of timing. The difference in period 1 profit is £9,375, which is the additional fixed cost carried forward under absorption costing. In the second period this forms part of the cost of sales and hence the absorption costing profits are £9,375 lower.

Which is Best?

It is generally agreed that marginal costing is more useful in decision making, where a choice has to be made between alternatives. Marginal costing shows the differential costs, which are more relevant for decision making.

However, a choice has to be made between marginal and absorption costing in the routine internal cost accounting system. There is no straightforward answer as to which system should be used. The system designer must consider all the advantages and disadvantages – and what is required from the system – before making a decision. It is therefore worth considering the arguments in favour of each system in turn.

(a) Arguments in Favour of Absorption (Full) Costing

- When production is constant but sales fluctuate, absorption costing will cause **fewer profit fluctuations** than marginal costing. Unnecessary concern could be caused by marginal costing in periods when stocks are being built up to match future increased sales demand (see previous example).
- No output can be achieved without incurring **fixed production costs**, and it is therefore logical to include them in stock valuations.
- If managers continually use marginal cost pricing, there is a danger that they may lose sight of the need to examine **fixed costs**. Absorption costing values all production at full cost, so that managers are always aware of fixed costs.

(b) Arguments in Favour of Marginal Costing

Supporters of the use of marginal costing systems would argue the following:

- When sales are constant but production fluctuates, marginal costing will give a more logical, constant **profit picture**.

- Since fixed costs accrue on a **time basis**, it is logical to charge them against sales in the period in which they are incurred. The internal costing system simply has to meet the information needs of managers. The marginal costing system will also give a better indication of the **actual cash flow** of the business.
- Under- or over-absorption of overheads is not a problem with marginal costing, and managers are never working under a **false impression of profit being made**, which could be totally altered by an adjustment for under- or over-absorbed overheads in absorption costing.

C. LIMITATION OF ABSORPTION COSTING

You have learned that marginal costing is more useful for decision making. Let us consider the following scenario. Bill Bloggs and Co., a small company, manufactures three products: the alpha, the beta and the gamma. It follows the principle of absorption costing, allocating both its factory fixed overheads and its selling fixed overheads on what it considers to be a correct basis. After six months, the following profit statement was produced.

Profit Statement – Total Cost Basis

Element of Cost	**Total Cost**	**Product Alpha**	**Product Beta**	**Product Gamma**
	£	£	£	£
Direct wages	12,000	3,000	4,000	5,000
Direct material	14,000	6,000	6,000	2,000
Factory overheads				
Variable	1,500	600	600	300
Fixed	3,000	1,000	1,000	1,000
Selling overheads				
Variable	3,000	2,000	700	300
Fixed	4,500	1,500	1,500	1,500
Total Cost	38,000	14,100	13,800	10,100
Sales Value	48,000	21,000	18,000	9,000
Profit/(Loss)	10,000	6,900	4,200	(1,100)

As a result of this situation, the decision is taken to stop production of Gamma, since it is a loss-making product. It is easy for Bill Bloggs and Co. to dispense with the services of the workforce producing Gamma as they are largely part-timers.

Production will concentrate on making Alpha and Beta only. No increase in sales of Alpha and Beta is possible in the next six months and fixed costs are not capable of being reduced. However, management looks forward to a better second half of the year with levels and standards of production being maintained. They assume their second half-yearly profits will be £11,100 (£10,000 + £1,100).

The second half of the year profit statement shows the following.

Profit Statement – Total Cost Basis

Element of Cost	**Total Cost**	**Product Alpha**	**Product Beta**
	£	£	£
Direct wages	7,000	3,000	4,000
Direct material	12,000	6,000	6,000
Factory overheads			
Variable	1,200	600	600
Fixed	3,000	1,500	1,500
Selling overheads			
Variable	2,700	2,000	700
Fixed	4,500	2,250	2,250
Total Cost	30,400	15,350	15,050
Sales Value	39,000	21,000	18,000
Profit/(Loss)	8,600	5,650	2,950

The peril of using absorption costing is clear! Management realised eventually by studying these figures that while they had "saved" the loss on Gamma of £1,100, Alpha and Beta had to bear the £2,500 fixed costs which had previously been borne by Gamma, hence the profits from Alpha and Beta were £2,500 less in total. Therefore + £1,100 – £2,500 = –£1,400. Hence the profit dropped from £10,000 to £8,600.

If the profit statement for the first six-month period had been set out in marginal costing format, it would have shown the following.

Profit Statement – Marginal Costing Basis

Element of Cost	**Total Cost**	**Product Alpha**	**Product Beta**	**Product Gamma**
	£	£	£	£
Sales	48,000	21,000	18,000	9,000
Direct wages	12,000	3,000	4,000	5,000
Direct material	14,000	6,000	6,000	2,000
Variable overheads				
Factory	1,500	600	600	300
Selling	3,000	2,000	700	300
Total Variable Cost	30,500	11,600	11,300	7,600
Contribution	17,500	9,400	6,700	1,400
Total Fixed Costs	7,500			
Profit	10,000			

Notice that Gamma has a contribution of £1,400 towards covering fixed costs. It is this amount that was lost when the wrong decision to cancel Gamma was made. Marginal costing clearly shows that Gamma should be retained.

It will be clear to you that however "correct" the basis on which fixed costs are allocated, it is nevertheless arbitrary.

Consider the situation in the first six months if, instead of allocating the fixed factory and selling overheads equally between Alpha, Beta and Gamma, they had been allocated in the ratio 3 : 2 : 1 (for some good reason). The profit statement for the first six months would have been as follows.

Profit Statement – Total Cost Basis

Element of Cost	Total Cost	Product Alpha	Product Beta	Product Gamma
	£	£	£	£
Direct wages	12,000	3,000	4,000	5,000
Direct material	14,000	6,000	6,000	2,000
Factory overheads				
Variable	1,500	600	600	300
Fixed	3,000	1,500	1,000	500
Selling overheads				
Variable	3,000	2,000	700	300
Fixed	4,500	2,500	1,500	750
Total Cost	38,000	15,350	13,800	8,850
Sales Value	48,000	21,000	18,000	9,000
Profit/(Loss)	10,000	5,650	4,200	150

Perhaps management might not then have considered taking corrective action to improve the situation!

It is the **allocation of fixed costs** which can cause wrong management decisions to be made in situations such as this.

D. APPLICATION OF MARGINAL AND ABSORPTION COSTING

To finish off this study unit we shall now look at some more complex comparisons between the two techniques.

The following example is based on a situation where sales and production differ; thereafter we shall consider the position when production is constant but sales fluctuate and finally when sales are constant but production fluctuates. In each case we shall examine which of the two methods is considered to give the more reasonable calculation of profit.

Where Sales and Production Differ

Using (a) marginal costing, and (b) absorption costing, prepare profit statements, given the following information.

	£
Per unit:	
Sales price	50
Direct material cost	18
Direct wages	4
Variable production overhead	3
Per month:	
Fixed production overhead	99,000
Fixed selling overhead	14,000
Fixed administration overhead	26,000
Variable selling overhead:	10% of sales value

Normal capacity was 11,000 units per month.

	March (Units)	**April** (Units)
Sales	10,000	12,000
Production	12,000	10,000

Answer

The valuation of units of production and stock will differ with each of the costing methods applied:

(a) ***Marginal Costing***

All units will be valued at the variable production cost of £25:

	£
Direct material cost	18
Direct wages	4
Variable production overhead	3
Total variable production cost	£25

Sales Price		£50
Production Variable Costs	£25	
Selling Variable O/H	£5	£30
Contribution		£20 per unit

Profit Statements for the Months of March and April Using Marginal Costing

	March		April	
	Units	*£000*	*Units*	*£000*
Sales @ £50	10,000	500	12,000	600
less Cost of sales:				
Opening stock @ £25	–	–	2,000	50
Variable cost of production @ £25	12,000	300	10,000	250
	12,000	300	12,000	300
less Closing stock @ £25	2,000	50		
	10,000	250	12,000	300
Variable selling overhead		50		60
Total variable cost of sales		300		360
Contribution		200		240
	£000		*£000*	
less Fixed overheads:				
Production	99		99	
Selling	14		14	
Administration	26		26	
		139		139
Net profit		61		101

Total net profit for March and April = £162,000

(b) ***Absorption Costing***

The valuation of units of production and stock will include a **share of the fixed production overhead** for the month. In this example, therefore, the rate for absorption of fixed production overheads should be based on an activity level of 11,000 units per month:

Therefore, fixed production overhead absorption rate = $\frac{£99{,}000}{11{,}000}$ = £9 per unit

Therefore, full production cost for one unit to be used in stock valuation is:

	£ per unit	
Variable cost	25	(as before)
Fixed production overhead	9	
	£34	

Profit Statements for the Months of March and April Using Absorption Costing

	March		April	
	Units	*£000*	*Units*	*£000*
Sales @ £50	10,000	500	12,000	600
less Cost of sales:				
Opening stock @ £34	–	–	2,000	68
Production cost absorbed @ £34	12,000	408	10,000	340
	12,000	408	12,000	408
less Closing stock @ £34	2,000	68	–	–
	10,000	340	12,000	408
Gross profit		160		192
Adjustment for over/(under)-absorption of overheads		9		(9)
		169		183
	£000		*£000*	
less Variable selling overhead	50		60	
Fixed selling overhead	14		14	
Fixed administration overhead	26		26	
		90		100
Net profit		79		83

Total net profit for March and April = £162,000

Calculation of Over/(Under)-Absorption of Fixed Production Overheads

	Production	**Overhead Absorbed Per Unit**	**Total Overhead Absorbed**	**Overhead Incurred**	**Over/(Under)-Absorption**
	Units	£	£	£	£
March	12,000	9	108,000	99,000	9,000
April	10,000	9	90,000	99,000	(9,000)

Note that the net profits for March and April together are the same under both methods – £162,000. This is because all of the stock is sold by the end of April and, therefore, all costs have been charged against sales. The adjustment for over-/under-absorption arises because in both months there was £99,000 fixed production overhead but in March 1,000 more units than normal were produced and in April 1,000 less.

The net profit figure for March is £18,000 higher using absorption costing, owing to £18,000 of fixed production overhead being carried forward in stock, to be charged against the sales revenue for April. Stock = 2,000 units × £9 = £18,000.

When Production is Constant but Sales Fluctuate

Absorption costing is usually considered more suitable in these circumstances.

Example

MC Ltd manufacture and sell a single product. Cost and revenue details of the product are as follows:

	£
Per unit:	
Sales price	20
Variable cost of production	6
Per month:	
Fixed production overhead	5,000
Fixed selling and administration overhead	3,000

It is MC's policy to maintain a constant production output at the normal capacity of 1,000 units per month, despite fluctuations in monthly sales levels. Sales achieved for the months of January to April were as follows:

	Units
January	400
February	500
March	1,400
April	1,700

You are asked to prepare profit statements for January to April, using:

(a) marginal costing;

(b) absorption costing.

Answer

(a) Profit Statements Using Marginal Costing

	January		February		March		April	
	Units	*£*	*Units*	*£*	*Units*	*£*	*Units*	*£*
Sales @ £20	400	8,000	500	10,000	1,400	28,000	1,700	34,000
less Cost of sales:								
Opening stock @ £6	–	–	600	3,600	1,100	6,600	700	4,200
Variable production cost @ £6	1,000	6,000	1,000	6,000	1,000	6,000	1,000	6,000
	1,000	6,000	1,600	9,600	2,100	12,600	1,700	10,200
less Closing stock @ £6	600	3,600	1,100	6,600	700	4,200	–	–
	400	2,400	500	3,000	1,400	8,400	1,700	10,200
Contribution		5,600		7,000		19,600		23,800
	£		£		£		£	
less Fixed overheads:								
Production	5,000		5,000		5,000		5,000	
Selling and administration	3,000		3,000		3,000		3,000	
		8,000		8,000		8,000		8,000
Profit/(Loss)		(2,400)		(1,000)		11,600		15,800

Total profit for the four months = £24,000

(b) Using Absorption Costing

Fixed production overhead absorption rate $= \frac{£5{,}000}{1{,}000}$ units

$= £5$ per unit

Therefore, full production cost = £5 + £6 variable cost per unit

= £11 per unit

Note that there will be no over- or under-absorption of fixed production overheads, because the production for every month is equal to the normal capacity of 1,000 units.

Profit Statements Using Absorption Costing

	January		February		March		April	
	Units	*£*	*Units*	*£*	*Units*	*£*	*Units*	*£*
Sales @ £20	400	8,000	500	10,000	1,400	28,000	1,700	34,000
less Cost of sales:								
Opening stock @ £11	–	–	600	6,600	1,100	12,100	700	7,700
Full production cost @ £11	1,000	11,000	1,000	11,000	1,000	11,000	1,000	11,000
	1,000	11,000	1,600	17,600	2,100	23,100	1,700	18,700
less Closing stock @ £11	600	6,600	1,100	12,100	700	7,700	–	–
	400	4,400	500	5,500	1,400	15,400	1,700	18,700
Gross Profit		3,600		4,500		12,600		15,300
less Fixed overheads:								
Selling and administration		3,000		3,000		3,000		3,000
Net Profit		600		1,500		9,600		12,300

Total profit for the four months = £24,000

You can see, therefore, that when production is constant but sales fluctuate each month, **absorption costing** will cause fewer profit fluctuations than marginal costing. Managers could have been caused concern if marginal costing had been used, because of the losses which this method would show in January and February. With absorption costing, the fixed production overheads were carried forward in stock, to be matched against the relevant revenue when it arose in March and April. In these circumstances no corrective action is necessary, **provided** the increase in sales in March and April was foreseen.

When Sales are Constant but Production Fluctuates

This is not likely to occur in practice but, in this situation marginal costing would show a constant level of profit linked to the constant sales.

Consider again the previous example of MC Ltd, and prepare profit statements using:

(a) marginal costing,

(b) absorption costing,

for January to April, based on the same cost data and the following activity levels:

	Sales Units	*Production Units*
January	1,000	1,900
February	1,000	1,000
March	1,000	600
April	1,000	500

Note: 1,000 units per month is still considered to be normal capacity.

(a) Profit Statements Using Marginal Costing

	January		**February**		**March**		**April**	
	Units	£	*Units*	£	*Units*	£	*Units*	£
Sales @ £20	1,000	20,000	1,000	20,000	1,000	20,000	1,000	20,000
less Cost of sales:								
Opening stock @ £6	–	–	900	5,400	900	5,400	500	3,000
Variable production cost @ £6	1,900	11,400	1,000	6,000	600	3,600	500	3,000
	1,900	11,400	1,900	11,400	1.500	9,000	1,000	6,000
less Closing stock @ £6	900	5,400	900	5,400	500	3,000	–	–
	1,000	6,000	1,000	6,000	1,000	6,000	1,000	6,000
Contribution		14,000		14,000		14,000		14,000
	£		£		£		£	
less Fixed overheads:								
Production	5,000		5,000		5,000		5,000	
Selling and administration	3,000		3,000		3,000		3,000	
		8,000		8,000		8,000		8,000
Profit/(Loss)		6,000		6,000		6,000		6,000

Total net profit for the four months = £24,000

(b) Profit Statements Using Absorption Costing

	January		February		March		April	
	Units	*£*	*Units*	*£*	*Units*	*£*	*Units*	*£*
Sales @ £20	1,000	20,000	1,000	20,000	1,000	20,000	1,000	20,000
less								
Cost of sales:								
Opening stock @ £11	–	–	900	9,900	900	9,900	500	5,500
Full production cost @ £11	1,900	20,900	1,000	11,000	600	6,600	500	5,500
	1,900	20,900	1,900	20,900	1,500	16,500	1,000	11,000
less								
Closing stock @ £11	900	9,900	900	9,900	500	5,500	–	–
	1,000	11,000	1,000	11,000	1,000	11,000	1,000	11,000
Gross Profit		9,000		9,000		9,000		9,000
Adjustment for over/ (under)-absorbed overheads		4,500		–		(2,000)		(2,500)
		13,500		9,000		7,000		6,500
less								
Fixed overheads:								
Selling and administration		3,000		3,000		3,000		3,000
Net Profit		10,500		6,000		4,000		3,500

Total net profit for the four months = £24,000

Calculation of Over/(Under)-Absorption of Fixed Production Overheads

	Production	Overhead Absorbed Per Unit	Total Overhead Absorbed	Overhead Incurred	Over/(Under)-Absorption
	Units	*£*	*£*	*£*	*£*
January	1,900	5	9,500	5,000	4,500
February	1,000	5	5,000	5,000	–
March	600	5	3,000	5,000	(2,000)
April	500	5	2,500	5,000	(2,500)

Where Resources are Limited

From what we have learnt so far, it will be clear that in Marginal Costing, the increase in profit arises from the increase in contribution and/or reduction in fixed costs. Normally an organisation will concentrate on increasing contribution by selling (subject to market conditions) those products which produce the greatest contribution **per unit**. Sometimes, however, there is a limit to the amount of resources available to the organisation, e.g. man hours, machine hours or raw materials. In this event the organisation should concentrate on selling the product(s) which produce the greatest contribution **per unit of limited resource**.

For example, we have three Products; A, B and C.

	A	**B**	**C**
	£	£	£
Selling Price per unit	10	12	16
Variable Cost per unit	4	7	14
Contribution	6	5	4

Obviously without a **limiting factor** it is best to sell as many items of A as possible, then B, then C. However suppose there is a limit on the man hours available and the following man hours are used on each unit:

A – 3 hours

B – 2 hours

C – 1 hour

The contribution per limiting factor becomes:

A: $\frac{£6}{3}$ = £2 contribution per man hour

B: $\frac{£5}{2}$ = £2.50 contribution per man hour

C: $\frac{£4}{1}$ = £4 contribution per man hour

Then the organisation should concentrate first on selling C, then B, then A and thus maximise contribution relative to the limited resource available.

SUMMARY

As you may gather from the preceding examples, there are arguments for and against both costing methods.

To summarise, the arguments put forward in favour of marginal costing are:

(a) It is inappropriate to apportion fixed costs over production because they are not affected by output and therefore should be charged in full to the period in question.

(b) Contribution varies directly with the level of sales; it is therefore much easier to assess likely profits using marginal costing rather than apportioning fixed overhead which will make the decision-making process more complex.

(c) Marginal costing is a simpler technique to understand and operate.

(d) There is always the danger that, under absorption costing, production will be increased to absorb fixed overheads over a larger number of units, thereby increasing short-term profits.

(e) It is more appropriate to value stocks at variable costs only.

The arguments in favour of absorption costing are:

- To comply with certain statutory stock reporting requirements, it is considered that absorption costing gives a truer view of the costs incurred in production.
- Apportioning fixed overhead ensures that, for decision-making purposes, fixed overhead is fully covered when setting selling prices.
- As fixed overhead is incurred in order to produce output, it is reasonable that such cost should be charged out.

Study Unit 6

Activity-Based and Other Modern Costing Methods

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INTRODUCTION

Having looked in detail at the traditional approaches of absorption and marginal costing, we will now concentrate in this study unit on up-to-date theories that have arisen in recent years, partly as a response to the shortcomings of the traditional methods.

Activity-based costing, on which the major part of this study unit is based, is an attempt to apply costs to the activities which cause them. As well as covering the theory of this method, consideration will also be given as to how results differ compared to the traditional methods.

Finally, throughput and backflush costing will be considered along with an appraisal of Just-In-Time (JIT) manufacturing and its impact on costing systems.

A. ACTIVITY-BASED COSTING (ABC)

Problems of Traditional Methods

Both the traditional absorption and marginal costing systems (used prior to activity-based costing) have fundamental weaknesses and can therefore be inaccurate as a means of costing. In the case of **marginal costing**, the main problem is that overheads are virtually ignored. This is because overheads are a "sunk" cost, i.e. they must be paid for regardless of the level of activity. Ignoring overheads tends to inflate profits artificially. The profit is, in effect, the contribution. The major danger, therefore, is that overheads are not allocated to products and may not be recovered when setting a selling price. As a result, the company may drift into loss and eventually go out of business.

Absorption costing, on the other hand, allocates or apportions all overheads to products. In order to do this, companies must allocate and apportion service overheads to the main production departments. Direct labour and/or machine hour rates are then calculated. Costs are therefore allocated to various departments and the process assumes that overheads relate directly to the level of production. The problem with this approach is that the allocation of costs is carried out on an arbitrary basis and may not reflect accurately on those activities which are truly responsible for the costs. Sometimes, a particular product or activity may show a loss simply because the ways in which costs are allocated have changed.

Absorption costing is also time-consuming. It requires a lot of time and energy to decide and implement a basis of overhead allocation and apportionment. However, this allocation process may obscure the main causes for these costs.

ABC theory has arisen as a result of dissatisfaction with traditional costing methods. It attempts to apportion costs in relation to activities. Specifically, the problems it intends to counteract are as follows:

(a) Traditional costing methods split costs between fixed and variable. It is argued, however, that the time-scales applicable to most projects make this approach redundant. Instead, costs should be looked at in terms of short-term and long-term, since most strategy decisions cover a three- to five-year time-scale during which period most costs can become variable.

(b) In addition, as businesses grow over a period of time, the complexity of the business increases also. Thus, costs vary due to this complexity and not necessarily with volume. A business which produces, for example, a hundred items will probably require more sophisticated support functions than a business which produces only one or two. When costs are allocated on volume, the products with the highest output will be allocated the highest level of apportioned cost. In reality, however, the items with the smaller volumes may take a disproportionate amount of time and material to set up, but will only be allocated a very small proportion of support cost.

(c) Many costing systems are based on financial costing systems and are therefore inappropriate for decision-making purposes. In particular, only production overheads may be absorbed into product cost for the purposes of stock valuation, whilst ignoring selling and administration overheads.

(d) Labour hours are often used as the basis for absorption, even though direct labour often forms a relatively small proportion of total cost.

Stages in Activity-Based Costing

The stages in activity-based costing are as follows:

(a) Identify those activities that cause overheads to be incurred.

(b) Adjust the accounting system so that costs are collected by activity rather than by cost centre.

(c) Identify those factors which cause each activity's costs to change (the cost drivers – see below).

(d) Establish the volume of each cost driver.

(e) Calculate the cost driver rates by dividing the activity's cost by the volume of its cost driver.

(f) Establish the volume of each cost driver required by each product.

(g) Calculate overheads attributable to each product by multiplying step (e) by step (f).

Certain jobs which are high volume in nature tend to be over-costed under the traditional system. This is because costs are often allocated based on the number of machine hours, etc. However, small, less routine jobs which can often prove troublesome are under-costed, simply because they do not use up too many machine hours, etc. This situation arises perhaps because there are additional costs associated with short-run production costs which are not adequately reflected in the company's costing system.

Cost Drivers

Emphasising the approach of ABC to identifying activities and their associated costs is the concept of "cost drivers" which can be defined as activities which cause costs rather than the costs themselves. A distinction can also be made between those processes which add value and those which do not. The importance of this is that processes which do not add value are potential areas for cost reduction without affecting the product itself.

Short-term variable costs may be allocated using volume-related cost drivers such as direct labour hours, machine hours, or direct material cost. Items such as electricity would be driven by machine hours and apportioned according to the variability of the driver. In a similar way, some items may vary with the value of materials consumed or with direct labour hours.

In terms of support functions, it is the transactions undertaken by the personnel of the support department which are the relevant cost drivers. A few examples will help to make this a little clearer.

- The number of goods inwards orders drives the goods inwards department.
- The number of production runs undertaken drives several items such as inspection, set-up and production scheduling costs.

- The number of despatch orders would drive the costs of the goods outwards department.

Once the cost drivers are identified, each one is designated as a cost centre to which are allocated all associated costs. In the goods outwards example, the costs identified with the cost centre are divided by the number of goods outwards to determine the charge-out rate. If, for example, costs were identified as £5,000 and 1,000 items were despatched, the charge-out rate would be £5 per item.

Advantages of ABC

The benefits put forward for the ABC approach include the following:

(a) The identification of costs with the activities which cause them becomes much clearer, the resultant "cause and effect" enhancing managerial control.

(b) Cost drivers can be used not only as a cost measure but also as a performance measure.

(c) The identification of costs from cost-driver analysis is helpful for budgeting within support departments.

(d) The availability of cost-driver rates can be used as an input into the design of new products and modification to existing ones.

(e) In overcoming some of the historic problems associated with cost allocation, the provision of costing information is viewed with much more confidence by the relevant managers.

(f) In comparison with traditional methods, costs will be allocated in different proportions, so highlighting unprofitable products that should either be improved or removed from the range.

Problems Encountered

ABC is a relatively new technique and the potential problems may appear only over a longer period of time as more investigation and analysis is undertaken in instances where it is installed in a "real life" situation. One thing that is unclear at present is the impact on motivation and managerial behaviour, because it is a new technique. The complete change from traditional methods may result in hostility to the new format, especially in large organisations where the "change aversion" culture is deep set. It may again prove to be the smaller, innovative companies where the technique proves most successful.

Other problems are as follows:

(a) The impact of ABC on profitability and cost reduction is as yet unclear also.

(b) The information produced is on a historic basis so care must be exercised when using it as a basis for future strategy.

(c) Initial problems are often encountered because of the change of emphasis on the cause of costs.

(d) The identification of cost drivers is not always obvious. If the wrong ones are identified the whole system will be incorrect.

(e) The reporting of activity-based costs often cuts across traditional boundaries of control when attempting to define responsibility. Care must be taken to ensure that the costs allocated to a cost centre or driver are controllable by the manager concerned.

Example

Product X is manufactured in long production runs, while product Y, even though it has more components, is manufactured in small batches.

		Product X		Product Y
Monthly production		5,000		6,000
Direct material costs				
Department A	£4.00		£5.00	
Department B	£4.00		£4.00	
Department C	£2.00	£10.00	£3.00	£12.00
Direct labour costs		£5.00		£7.00
Machine hours				
Department A		0.5		0.6
Department B		0.5		0.9
Department C		0.25		0.5

In addition, the following overheads are incurred:

	£
Production department overheads	
Department A	20,000
Department B	15,000
Department C	10,000
Service department overheads	
Purchasing	6,000
Production control	5,000
Tool setting	12,000
Maintenance	3,000
Quality control	4,000

(a) Product Costs Calculated Using Absorption Costing

The first step is to apportion the service department overheads to the production departments. In this example we will use the following basis of apportionment:

- Purchasing: direct material costs
- Production control: direct material costs
- Tool setting: direct material costs
- Maintenance: machine hours
- Quality control: machine hours

We can calculate the monthly material costs and machine hours from the previous data as follows:

	Department A	**Department B**	**Department C**	**Total**
Machine hours				
Product X	2,500	2,500	1,250	6,250
Product Y	3,600	5,400	3,000	12,000
Total	6,100	7,900	4,250	18,250
Department % of total	33.42%	43.28%	23.28%	100%
Direct materials				
Product X	20,000	20,000	10,000	50,000
Product Y	30,000	24,000	18,000	72,000
Total	50,000	44,000	28,000	122,000
Department % of total	40.98%	36.06%	22.95%	100%

We can now prepare the overhead analysis sheet apportioning service department overheads to production departments.

Overheads	**Cost**	**Basis**	**Dept A**	**Dept B**	**Dept C**
	£		£	£	£
Production overheads:					
Department A	20,000		20,000		
Department B	15,000			15,000	
Department C	10,000				10,000
Service overheads:					
Purchasing	6,000	*(direct materials)*	2,459	2,164	1,377
Production control	5,000	*(direct materials)*	2,049	1,803	1,148
Tool setting	12,000	*(direct materials)*	4,918	4,327	2,754
Maintenance	3,000	*(machine hours)*	1,003	1,298	698
Quality control	4,000	*(machine hours)*	1,337	1,731	931
Total	75,000		31,766	26,323	16,908

We can now calculate a machine hour rate as follows:

	Dept A	Dept B	Dept C
Total cost	£31,766	£26,323	£16,908
Machine hours	6,100	7,900	4,250
Rate per hour	£5.21	£3.33	£3.98

And finally, on the basis of the hourly usage, we can now allocate overheads as follows:

	Dept A	Dept B	Dept C	Total
Rate per hour	£5.21	£3.33	£3.98	
Hours Product X	0.5	0.5	0.25	
Overhead charge X	£2.60	£1.67	£0.99	£5.26
Hours Product Y	0.6	0.9	0.5	
Overhead charge Y	£3.13	£3.00	£1.99	£8.12

(b) Cost Calculation Using Activity-Based Costing

With activity-based costing we try to identify the "cost drivers". The cost drivers determine the cost level and may be categorised in the above example as follows:

Activity	***Cost Driver***
Purchasing	Number of orders
Production control	Number of components produced
Tool setting	Number of tool changes
Maintenance	Machine hours
Quality control	Number of components inspected
Production Dept A	Machine hours
Production Dept B	Machine hours
Production Dept C	Machine hours

In order to keep this example simple, we assume that the production department overheads are directly related to machine hours worked. In practice we might find it worthwhile to divide each department into a number of different activities, each with their own "cost driver".

In order to carry out the allocation of overheads on the basis of activity-based costing we shall need additional information as follows:

Cost Driver	Product X	Product Y	Total
Number of orders	300	900	1,200
Number of components produced	15,000	48,000	63,000
Number of tool changes	10	60	70
Machine hours	6,250	12,000	18,250
Number of components inspected	2,000	11,000	13,000
Total			95,520

On the basis of the above information we can now make the following calculations:

Cost Driver	Cost	Allocation	Allocation Rate
Number of orders	£6,000	1,200	£5.00
Number of components produced	£5,000	63,000	£0.08
Number of tool changes	£12,000	70	£171.43
Machine hours	£3,000	18,250	£0.16
Number of components inspected	£4,000	13,000	£0.31
Machine hours Dept A	£20,000	6,100	£3.28
Machine hours Dept B	£15,000	7,900	£1.90
Machine hours Dept C	£10,000	4,250	£2.35

The allocation under activity-based costing is:

Cost Driver	Product X £	Product Y £	Total £
Number of orders	1,500	4,500	6,000
Number of components produced	1,190	3,810	5,000
Number of tool changes	1,714	10,286	12,000
Machine hours	1,027	1,973	3,000
Number of components inspected	615	3,385	4,000
Production Dept A	8,197	11,803	20,000
Production Dept B	4,747	10,253	15,000
Production Dept C	2,941	7,059	10,000
Total	£21,931	£53,069	£75,000
Quantity produced	5,000	6,000	
Overhead per product	£4.39	£8.84	

In the case of purchasing the calculation for Product X is £1,500 (£5 rate per order multiplied by 300 number of orders for Product X). Note that correcting to 2 decimal places may make figures difficult to reconcile.

Product Y's cost is greater than that obtained from the traditional absorption costing method and reflects the additional costs involved in its manufacture.

Criticism of the Activity-Based Costing Technique

Although activity-based costing is a more accurate method of allocating costs, its major weakness lies in its complexity. As you can see from the example, you need a considerable amount of information before activity-based costing can apply. For instance, we needed to know the number of orders, the components produced, the components inspected, etc. All this information may be difficult to obtain and may also be inaccurate. The result is that costs may be apportioned on an incorrect basis. It is likely that only large companies will resort to activity-based costing techniques.

Nevertheless, as a student, activity-based costing will help you to understand exactly what management accounting is trying to achieve. The traditional methods of costing are often unreliable, because they penalise large volume projects even though such projects may be relatively straightforward to implement and may involve only minimum administration costs.

Example

Assume that you are given the following information about a company that makes compact discs and LP records:

		Compact Discs		Records
Monthly production		15,000		5,000
Direct material costs				
Pressing Dept	£5.00		£6.00	
Cutting Dept	£5.00		£7.00	
Packing Dept	£3.00	£13.00	£2.00	£15.00
Direct labour costs		£5.00		£7.00
Machine hours				
Pressing Dept		0.6		0.5
Cutting Dept		0.6		0.5
Packing Dept		0.5		0.3

In addition, the following overheads are incurred:

	£	*Basis of Apportionment*
Production department overheads		
Pressing Dept	25,000	
Cutting Dept	30,000	
Packing Dept	16,000	
Service department overheads		
Purchasing	7,000	*direct material costs*
Production control	5,000	*direct material costs*
Set-up costs	12,000	*direct material costs*
Maintenance	3,000	*machine hours*
Quality control	4,000	*machine hours*

Question 1

The company wishes to introduce a pricing system which is 20% mark-up on marginal costs. Calculate the price it should charge for compact discs and records. Outline the disadvantages associated with this approach.

Solution

Under the marginal cost pricing method we apply the mark-up on variable costs only. Fixed costs are ignored. Therefore the price which we charge is calculated as follows:

	Compact Discs		Records	
	£	£	£	£
Direct material costs:				
Pressing Dept	5.00		6.00	
Cutting Dept	5.00		7.00	
Packing Dept	3.00	13.00	2.00	15.00
Direct labour costs		5.00		7.00
Total variable costs		18.00		22.00
Mark-up 20%		3.60		4.40
Price		£21.60		£26.40

The **disadvantage** with this approach is that we fail to consider fixed costs. If the volume sold is very high then the fixed cost overhead charge may be insignificant because the costs are allocated over a large number of products. However, if we fail to consider fixed costs, then the company could incur losses.

Question 2

The company decides to charge 15% on full cost (absorption basis). What will the new price be for compact discs and records? Outline the advantages of the absorption approach in this case.

Solution

If the company adopts the absorption approach, it needs to prepare the following schedule:

	Pressing Dept	Cutting Dept	Packing Dept	Total
Machine hours				
Compact discs	9,000	9,000	7,500	25,500
Records	2,500	2,500	1,500	6,500
Total	11,500	11,500	9,000	32,000
Department % of total	35.94%	35.94%	28.12%	100%
Direct materials				
Compact discs	75,000	75,000	45,000	195,000
Records	30,000	35,000	10,000	75,000
Total	105,000	110,000	55,000	270,000
Department % of total	38.89%	40.74%	20.37%	100%

On the basis of this we can now allocate the overheads as follows:

Overheads	**Cost** £	**Basis**	**Pressing** £	**Cutting** £	**Packing** £
Production overheads:					
Pressing Dept	25,000		25,000		
Cutting Dept	30,000			30,000	
Packing Dept	16,000				16,000
Service overheads:					
Purchasing	7,000	*(direct materials)*	2,722	2,852	1,426
Production control	5,000	*(direct materials)*	1,944	2,037	1,019
Set-up costs	12,000	*(direct materials)*	4,667	4,889	2,444
Maintenance	3,000	*(machine hours)*	1,078	1,078	844
Quality control	4,000	*(machine hours)*	1,438	1,437	1,125
Total	102,000		£36,849	£42,293	£22,858

The department hourly rates are therefore:

	Pressing Dept	**Cutting Dept**	**Packing Dept**
Total cost	£36,849	£42,293	£22,858
Machine hours	11,500	11,500	9,000
Rate per hour	£3.20	£3.68	£2.54

We can now allocate these hourly rates to the compact discs and records as follows:

	Pressing Dept	**Cutting Dept**	**Packing Dept**	**Total**
Hours Compact discs	0.6	0.6	0.5	
Overhead charge Compact discs	£1.92	£2.21	£1.27	£5.40
Hours Records	0.5	0.5	0.3	
Overhead charge Records	£1.60	£1.84	£0.76	£4.20

Finally, we can calculate the full cost price as follows:

	Compact Discs		Records	
	£	£	£	£
Direct material costs:				
Pressing Dept	5.00		6.00	
Cutting Dept	5.00		7.00	
Packing Dept	3.00	13.00	2.00	15.00
Direct labour costs		5.00		7.00
Total variable costs		18.00		22.00
Fixed cost allocation		5.40		4.20
Total cost		23.40		26.20
Mark-up 15%		3.51		3.93
Price		£21.91		£30.13

The **advantage** of this approach is that we consider fixed costs and therefore price the products with the intention of recovering those fixed costs. The disadvantage is that costs are allocated on an arbitrary basis, which bears no relationship to the level of activity involved. Strictly speaking, although the process of making compact discs may be more complex, there is still the benefit that we are dealing in large quantities compared to records and therefore the fixed cost per unit should ideally be a lot lower than it is.

Question 3

The company decides to continue charging 15% on full cost, but this time they use activity-based costing rather than the conventional absorption approach. Show the new pricing policy and outline the advantages and disadvantages of the new approach.

You may find the following information helpful:

Activity	***Cost Driver***
Purchasing	Number of orders
Production control	Number of components produced
Tool setting	Number of tool changes
Maintenance	Machine hours
Quality control	Number of components inspected
Pressing Dept	Machine hours
Cutting Dept	Machine hours
Packing Dept	Machine hours

Cost Driver	Compact Discs	Records	Total
Number of orders	200	2,000	2,200
Number of components produced	12,000	50,000	62,000
Number of tool changes	100	200	300
Machine hours	6,000	15,000	21,000
Number of components inspected	4,000	13,000	17,000
Total	22,300	80,200	102,500

Solution

The first step is to calculate the cost-driver rates:

Cost Driver	Cost	Allocation	Allocation Rate
Number of orders	£7,000	2,200	£3.18
Number of components produced	£5,000	62,000	£0.08
Number of tool changes	£12,000	300	£40.00
Machine hours	£3,000	21,000	£0.14
Number of components inspected	£4,000	17,000	£0.24
Pressing Dept	£25,000	11,500	£2.17
Cutting Dept	£30,000	11,500	£2.61
Packing Dept	£16,000	9,000	£1.78

We now allocate the costs between the products:

Cost Driver	**Compact Discs** £	**Records** £	**Total** £
Number of orders	636	6,364	7,000
Number of components produced	968	4,032	5,000
Number of tool changes	4,000	8,000	12,000
Machine hours	857	2,143	3,000
Number of components inspected	941	3,059	4,000
Pressing Dept	19,565	5,435	25,000
Cutting Dept	23,478	6,522	30,000
Packing Dept	13,333	2,667	16,000
Total	£63,778	£38,222	£102,000
Quantity produced	15,000	5,000	
Overhead per product	£4.25	£7.64	

In the case of orders the £636 represents the number of orders for compact discs multiplied by the allocation rate of £3.18. All the other figures can be obtained using the same method. (Again allow for rounding errors.)

We now return to our pricing chart but taking the new overhead charges into consideration.

	Compact Discs		**Records**	
	£	£	£	£
Direct material costs:				
Pressing Dept	5.00		6.00	
Cutting Dept	5.00		7.00	
Packing Dept	3.00	13.00	2.00	15.00
Direct labour costs		5.00		7.00
Total variable costs		18.00		22.00
Fixed cost allocation		4.25		7.64
Total cost		22.25		29.64
Mark-up 15%		3.34		4.45
Price		£25.59		£34.09

The Debate About ABC

> *"... (Activity-based costing) certainly ranks as one of the two or three most important management accounting innovations of the twentieth century"*
> (H. T. Johnson quoted in the Foreword to Innes, J. and Mitchell, F.(1991) Activity-Based Cost Management – A Case Study of Development and Implementation, London, CIMA).

> *"... (Activity-based costing) is on the surface appealing and logical, but it does not stand up to close scrutiny"*
> (Piper, J. A. and Walley, P., "Testing ABC Logic" in Management Accounting, September 1990).

Absorption costing and marginal costing approaches have their critics but the accuracy of ABC systems is also challenged by some writers, as it is probably necessary to adopt simplifying assumptions in order to keep down the number of cost drivers. Despite improvement arising from the ABC approach, it is still necessary to apportion some overheads, such as rent and rates, to products on what may still be considered an arbitrary basis.

The accuracy of ABC methods can certainly be challenged but it needs to be recognised that those companies which have introduced the approach do not consider more accurate product costs as the main reason for change. The prime motive has been the belief that ABC will help them understand the nature of costs and the factors that "drive" them. They appreciate, too, that the involvement of the management team in the investigative processes necessary to identify activities and drivers should also lead to improvements and cost reduction. It is not, therefore, solely a costing technique.

In conclusion, it must be appreciated that production techniques have changed dramatically in recent years with the advent of Total Quality Management and Just-in-Time (JIT) production. Costing techniques must also change. Traditional methods measure machine and factory efficiency and put a cost on machinery and equipment that is not fully utilised. These costing techniques have encouraged production management to adopt long production runs in order to improve efficiency. This has led sometimes to high stock levels and inflexibility, as in some cases it will not be economical to introduce product improvements and design changes until stocks have been consumed. There are also additional handling costs and damage associated with higher stock levels. ABC focuses on the activities that cause costs to be incurred and the drivers that cause them to change. This should improve the quality of management's decisions and lead to improved profitability.

B. THROUGHPUT ACCOUNTING

One of the potential drawbacks with the concept of ABC is that whilst it is useful for medium- to long-term decisions, it largely ignores the impact of short-term decisions.

Because of the rapid changes that have occurred within manufacturing, both in terms of concept (such as JIT, etc.) and process (i.e. robotics and automation in general), accounting systems designed to monitor and control them have had to be adapted also. Perhaps the greatest change has occurred in the nature of costs:

(a) Companies using JIT and similar techniques now hold much lower stock levels.

(b) The increasing level of automation means a greater proportion of costs are fixed.

(c) As a consequence of (b), the level of direct labour has also fallen.

The concept of throughput accounting attempts to recognise this shift in fixed costs and also overcomes one of the difficulties with ABC by concentrating on the short term. It does this by assuming that all costs except those of materials are fixed in short time spans. In addition, it takes the view that traditional costing systems are wrong to value stocks and work-in-progress as cost plus added value, because this results in an incorrect value being accorded to them. Instead, it sees the speed of response to customer demand as important and views levels of stock as inefficiency in the ability to meet that demand (i.e. if customer demands cannot be met immediately, this will result in a buffer of stock being held and this is inefficient).

Furthermore, bottlenecks should be concentrated on to ensure maximum utilisation of resources; it is pointless running one machine at maximum capacity whilst there is a bottleneck elsewhere, as this is merely producing more work-in-progress.

Throughput accounting is consistent with JIT in that it aims for minimal stock levels by concentrating on areas of constraint, but it has been severely criticised because it concentrates too much on the short term.

C. BACKFLUSH ACCOUNTING

The CIMA definition of backflush accounting is as follows:

> *"A cost accounting system which focuses on the output of an organisation and then works backwards to attribute costs to stock and cost of sales."*

The aim of backflush accounting is simplification; the idea is to allocate conversion costs at certain points in the production process, i.e. at the point where materials are requisitioned, after the first process, and so on. There is no maximum or minimum number of these points and the easiest way is to charge when materials are issued and the goods completed.

Conversion costs consist of the labour and overhead required to produce the finished goods and are charged at standard cost. A variance between the actual incurred and standard charged is written off.

Example

MNO Ltd has incurred the following costs over the year:

Sales	250,000 items @ £10 each
Direct labour cost	£800,000
Raw materials cost	£1,250,000
Finished goods produced	260,000 items

The company operates a system of backflush accounting and the following information is also relevant:

Standard cost of raw material per unit	£4.80
Standard conversion cost per unit	£3.10
Standard cost per unit	£7.90

If we assume that there are no opening stocks then the system of backflush accounting will calculate the cost of sales as follows:

Raw materials	250,000 × £4.80	= £1,200,000
Conversion cost	250,000 × £3.10	= £775,000
Total cost	250,000 × £7.90	= £1,975,000

Gross profit will therefore be:

	£
Sales (250,000 × £10)	2,500,000
Direct cost (as above)	1,975,000
Gross profit	525,000

Raw materials in stock will be:

	£
Purchased	1,250,000
less Allocated to finished goods (260,000 × 4.80)	(1,248,000)
	2,000

Finished goods in stock will be:

	£	
Raw materials used (as above)	1,248,000	
plus Conversion cost allocated (260,000 × £3.10)	806,000	
less Allocated to cost of sales	(1,975,000)	
	£79,000	*(10,000 units @ £7.90)*

The difference between conversion cost incurred (£800,000) and the amount allocated (£775,000) of £25,000 is written off at the end of the financial year.

This system of cost allocation therefore does away with the need to calculate many different overhead allocations as with a traditional system.

As with throughput accounting, backflush accounting is based on the view put forward earlier that with increasing usage of JIT, overall stock levels will decrease, with the result that it is difficult to justify having a complex system to calculate stock values.

D. JUST-IN-TIME (JIT) MANUFACTURING

Features

In the context of what we have covered so far in this study unit, JIT is a modern manufacturing concept with radical implications for the associated costing systems. It is a method of providing production with the inputs it requires as and when they are needed.

A common misconception is that JIT is purely a form of stock control, whereas it is in effect an overall management philosophy covering all aspects of the production process.

(a) Quality

This is not necessarily quality of the product to the final customer, but rather quality in the following terms:

- Products should be standardised and easy to produce.
- Processes, e.g. plant layout and tool and machinery design, are of critical importance.
- Suppliers should consist of a small number, each of whom provides proven quality in terms of product and delivery deadlines.

(b) Purchasing

This is the most well known aspect whereby small numbers of items are delivered when required, but much more frequently.

(c) Production Control

Final customer demand forms the basis of the determinants of output and therefore materials used. The "demand pulling" of materials can be centralised with traditional "pushing" methods where the size of the economic batch quantity determines materials usage requirements. The speed of production should also be dictated by the needs of the customer, i.e. how quickly the items are required.

In addition, set-up times do not add value and should therefore be eliminated or reduced as much as possible.

(d) Employee Involvement

Employees are expected to be much more flexible in addition to experiencing greater levels of participation and responsibility.

Goals

(a) Elimination of Non-Value-Adding Activities

JIT is dedicated to the elimination of **waste**, which is defined as anything that does not add value to a product. In manufacturing, the following activities occur **before** the item is sold (this is called the **lead time**):

- process time
- inspection time
- move time
- queue time
- storage time.

Of these five activities only **process time** adds value to the product. The other activities, in JIT terms, are non-value-adding activities. The idea of JIT is to reduce the lead time until it equals the process time.

The first stage in implementing a JIT system involves the rearrangement of the factory layout. In a traditional or functional plant layout similar machines are grouped together, and the item being manufactured travels from department to department as the various manufacturing processes occur to the item, e.g. the item will go to the drilling department, then to the grinding department, then to the turning department.

In a JIT system dissimilar machines are arranged, often in a U shape, around a JIT cell which manufactures the item. Each member of the cell can operate all the machines and the aim is that the item is manufactured without ever leaving the cell. The item does not go back to store or sit around awaiting the next process. JIT uses what is known as **cellular manufacturing**.

As we said earlier, the aim of JIT is to produce the right part at the right time. This results in the "**pull**" **manufacturing system** as opposed to traditional manufacturing methods, which are called "**push**" **manufacturing systems** because the items **push** their way from department to department, often resulting in them waiting in queues for the next process.

(b) Zero Inventory

As you will see from the description of JIT as a pull manufacturing system, the idea is that items are only produced as they are required and thus no large stocks of manufactured goods are accumulated.

(c) Zero Defect

JIT is based on "doing it right first time". In a conventional system it is assumed that some items will become defective and some departments will suffer breakdowns. This results in the maintenance of stocks of work-in-progress to provide work for departments at all times. It also results in high stock levels which JIT does not sanction.

(d) Batch Size of One

Small batches of items are usually avoided because the cost of setting-up the machines is too high to make small batches economic. As JIT works to eliminate set-up time as it is a non-value-adding activity, batch sizes can be reduced, thus preventing the development of bottlenecks, which occur when long production runs are used.

(e) Zero Breakdown

Zero breakdown is aimed for by planning for preventive maintenance to be carried out within the cell; all members are trained not only to use but also to maintain their machines. Breakdowns can thus be reduced significantly and repair carried out more quickly should a breakdown occur.

(f) 100% On Time Delivery

If the previous aims are achieved then it follows that delivery will always be on time.

(g) JIT Purchasing

The principles of JIT are applied equally to all outside purchases of components. Suppliers must not only supply on time in the quantities required, but must also guarantee quality. This saves costs by eliminating handling costs as inspection is no longer needed.

Cost Savings Under JIT

As we have seen, the main objective of JIT is to eliminate or reduce those tasks which do not add value to the final product. As a numerical example of the savings that can occur under a JIT system, consider the following example.

Example

Non-JIT Ltd and JIT Ltd produce identical goods from similar raw materials. The following are the costs applicable to Non-JIT Ltd and JIT Ltd:

	Non-JIT Ltd £	**JIT Ltd** £
Materials inspection costs	75,000	–
Materials storage costs	30,000	–
Materials movement costs	25,000	10,000
Process 1 costs	45,000	45,000
Process 2 costs	35,000	35,000
JIT costs	–	25,000
Factory overhead apportioned	50,000	50,000
Total cost	260,000	165,000

Notes

- Materials inspection costs include costs incurred when goods are received as well as final inspection. The objective is to ensure a close enough liaison with suppliers so that materials received are of sufficient quality that obviates the need for them to be inspected. In a similar way operatives are trained to monitor their own quality control to remove the need for a final inspection.
- Because materials will be received as and when required, there should be no need to store them before they are processed. If the layout of the factory is reorganised, it should also remove the need to store between processes.
- Materials movement costs will be lower as a result of less moving to and from storage.
- JIT costs could include increased payments to operatives for them to inspect their work, allocation of costs for changing the layout of the factory and so on.

From our example we can also calculate the cost saving per item and translate this into the potential saving that could be passed on to the customer. Suppose that the number of items produced was 20,000; the cost per item for Non-JIT Ltd would be £13 (£260,000/20,000) whilst the cost per item for JIT Ltd is £8.25 (£165,000/20,000).

Therefore the cost saving per unit is £4.75 at the JIT cost level, which represents 36% of original cost. Decisions can then be made as to whether or not to pass some or all of the saving to the customer.

Advantages of JIT

(a) Work-in-progress and stock levels are reduced, representing cost savings of working capital requirements.

(b) Much smoother production flow should lead to increased productivity.

(c) Improvements in quality should result in less rework.

(d) Because of shorter production times, paperwork is reduced, e.g. the amalgamation of the stores and work-in-progress account.

Disadvantages of JIT

(a) The JIT technique is tailored to situations of regular demand, relatively unchanging processes and a large percentage of common components. Thus, it is not necessarily suitable for all types of production. Problems can arise if attempts are made to implement JIT in situations which do not match its requirements. It is possible, however, to introduce parts of the philosophy on an individual basis.

(b) Implementation is over a very long time-scale and a large degree of patience is required by those whose responsibility it is.

(c) JIT involves a different cultural approach from that traditionally to be found in Western manufacturing industries – particularly in terms of consensus decision-making.

(d) JIT is considered weak in terms of medium- and long-term planning.

Study Unit 7

Product Costing

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INTRODUCTION

Previous study units have looked at how costs for particular products are built up, how overheads are allocated and so on. This study unit will concentrate on costing systems. Different types of business operate with different costing systems – which could be job, batch, contract or process costing.

We start by looking at job, batch and contract costing, concentrating on the methods for accumulating and applying cost as well as reviewing the circumstances under which each system operates most effectively.

We shall see that these systems are relevant to those situations where a separately identifiable unit (or units) is being produced. In situations where this is not the case, process costing is used. Thus, where continuous production is in operation, such as chemicals, paper, foods and drinks, textiles, etc., then this method needs to be used. We shall consider the basics of process costing and go on to look at some of the problems which are particular to this method, such as losses in process, dealing with common costs and the differences between joint and by-products.

A. COSTING TECHNIQUES AND COSTING METHODS

An initial distinction must be made between costing techniques and costing methods.

(a) Costing Techniques and Principles

Costing techniques and principles – such as marginal costing, absorption costing, incremental costing, differential costing, budgetary control and standard costing – are of general application to different industries and services. These techniques are used for purposes of decision making and control over costs and performance and they are applicable to all types of manufacturing and service industries.

(b) Costing Methods

Costing methods refers to the system (or systems) adopted to arrive at the cost of products or services within a particular organisation.

The type of costing system to be adopted should be tailored to meet the needs of the individual business and its manufacturing processes.

Two main types of product costing system are used:

- **Job costing** is used where products or batches of products are made to individual customer specifications. Examples include general engineering, printing, foundries, contracting, and building. Individual cost analyses are prepared for each separate order.
- **Process costing** applies where large quantities are made in a continuous flow or by repetitive operations. The total costs incurred are averaged over all production (see the next study unit).

B. JOB COSTING

Definitions

The CIMA Official Terminology refers to job costing as applying:

> *"....where work is undertaken to customers' special requirements and each order is of comparatively short duration (compared with those to which contract costing applies).*
>
> The work is usually carried out within a factory or workshop and moves through processes and operations as a continuously identifiable unit. The term may also be applied to work such as property repairs and the method may be used in the costing of internal capital expenditure jobs."

Businesses that operate in a job-costing environment generally do not manufacture for stock but instead to specific customer requirements. Very often an enquiry will be received from a prospective customer asking the firm to quote for producing a particular item. The estimating department will price up the potential work using standard charge-out rates based on its job costing system.

Pricing (which we will be looking at in more detail in a later study unit) is generally on a "cost-plus" basis. This means that a standard percentage is added to the calculated cost to arrive at the price to the customer.

Not all work is arrived at in this way; the foregoing example only applies where new business is involved. Very often the work undertaken by a firm operating a job-costing system will be repeat business and the cost of such work will already be known.

Procedure

(a) Setting up the System

There are two main items to which attention must be paid when setting up a method of job costing:

- We must first establish what is to be considered as a **job** – this being our logical unit of cost. In factories where job costing is employed, we may look upon the job in any of the following ways:
  - (i) An order for one large unit of production which has to be made to specification.
  - (ii) An order for a quantity of stock units of production which is required to keep up the warehouse supply.
  - (iii) A number of small orders for the same unit of production which can be conveniently accumulated into a batch and regarded as a single job.
- There must be an adequate method in operation whereby it is possible to allocate **distinctive numbers** to the various jobs which have to be done, so that cost can be coded by reference to the job number.

(b) Total Cost of Each Job

The total cost of each job is obtained by labelling cost as it occurs with the number of the job on behalf of which the cost was expended. The collection of these labelled costs will give the **total job cost**.

Elements of Cost Involved

We shall now consider the elements of cost which are involved, and decide on the techniques which should be used in cost collections to obtain the appropriate cost for each job number.

(a) Accounting for Materials

When dealing with the control of materials, material issued from stores has to be signed for on a **stores requisition slip**. The description and quantity of material issued is shown on this slip. If we associate the correct job number with each slip, we have the basis for associating materials used with the jobs for which they were used. Of course, where the material is indirect, the slip will bear the reference number of the appropriate **overhead account**.

Copies of the stores requisition slips will be passed to the costing department, to be priced and entered, and at the end of each costing period, they are analysed by job number and to the appropriate job account – or to an overhead account, in the case of indirect material. The total material cost posted to the debit of job and overhead accounts will, of course, equal the total of the postings to the credit of the individual stores ledger accounts.

(b) Accounting for Labour

We discussed the booking of time spent within the factory in an earlier study unit.

Wages will be charged as follows:

Direct wages	– direct time	– charged to job number
	– idle time	– charged to overheads
Indirect wages	– charged to overheads	

The data will be obtained in the following ways:

- The charges for labour applicable to overheads will be obtained from the **gate cards** of the indirect workers. If indirect workers serve several cost centres in the course of the week, they will fill up job cards showing the time spent on each, and the cost centre reference number.
- The direct labour force will be issued with a **job card** on which they will record the time spent on each job, and its number. The job cards will be analysed and the relevant amount posted to each job account.

(c) Accounting for Overheads

Overheads are charged to the various cost units in a costing routine by means of a system of precalculated **overhead absorption rates**. The method to be used will vary from system to system, and it is almost certain that a variety of methods will be used in each organisation, dependent on the characteristics of the various cost centres, e.g. some will use a rate per machine-hour and others a rate per labour-hour. This will give a fairer allotment of cost than the use of a blanket (average) rate to cover the whole organisation.

(d) The Job Account

We have now discussed the elements of cost involved in a factory job costing system, and the techniques we would use to establish the charges for each cost element to be made to each job. It is essential that this information be assembled in a systematic fashion, and we do this by opening a **separate job account** in the cost ledger for every job that we undertake. The number of this account will be the job number originally allotted to the unit of cost.

The method of entering the information in the books of account is straightforward but the job account would, normally, be analysed into direct materials, direct labour, direct charges, production overhead by cost centre, administration and selling costs where these are apportioned between products.

Specimen Cost Calculations for a Job

Job number 707, the copper plating of 100 tubes, was completed in three departments of a factory. Cost details for this job were as follows:

Department	**Direct Materials** £	**Direct Wages** £	**Direct Labour Hours**
X	650	800	1,000
Y	940	300	400
Z	230	665	700

Works overhead is recovered on the basis of direct labour hours and administrative overheads as a percentage of works cost.

The figures for the last cost period for the three departments on which the current overhead recovery rates are based, were:

Departments	**X**	**Y**	**Z**
Direct material	£6,125	£11,360	£25,780
Direct wages	£9,375	£23,400	£54,400
Direct labour hours	12,500	36,000	64,000
Works overhead	£5,000	£7,200	£9,600
Administrative overhead	£2,870	£14,686	£8,978

You are required to draw up a cost ledger sheet, showing the cost of job 707, and to show the price charged, assuming a profit margin of 20% on total cost.

Answer

(a) Calculation of Works Overhead Recovery Rate

	Department		
	X	**Y**	**Z**
Works overhead	£5,000	7,200	9,600
Direct labour hours	12,500	36,000	64,000
Recovery rate per direct labour hour	£0.40	0.20	0.15
Direct labour hours spent on job 707	1,000	400	700
Works overhead recovered on job 707	£400	80	105

(b) Calculation of Administrative Overhead Recovery Rate

	Department		
	X	**Y**	**Z**
Direct materials	£6,125	11,360	25,780
Direct wages	£9,375	23,400	54,400
Works overhead	£5,000	7,200	9,600
Works cost	£20,500	41,960	89,780
Administration overhead	£2,870	14,686	8,978
Administration overhead as % of works overhead	14%	35%	10%

Cost of Job 707

	Department			Total
	X	**Y**	**Z**	
	£	£	£	£
Direct materials	650	940	230	1,820.00
Direct wages	800	300	665	1,765.00
Works overhead (from (a))	400	80	105	585.00
Works cost	1,850	1,320	1,000	4,170.00
Administration overhead (applying percentages found in (b))	259	462	100	821.00
Total cost	2,109	1,782	1,100	4,991.00
Profit margin 20%				998.20
Price to be charged				5,989.20

Job Costing Internal Services

In those instances where an internal support department such as maintenance or marketing exists, it can be more efficient to treat the work done by it on a job-costing basis rather than by arbitrary allocation of the costs it incurs.

The advantages of such a system are as follows:

- More efficient use of resources – user departments will be much more aware of what they are being charged for when they take advantage of the internal service. In this way, user departments should be more careful in how they use the service. Where a system of arbitrary cost allocation exists, some user departments may overuse the service department on the basis that it will not cost them any more to do so.
- Correct allocation of resources – the costing of work is made easier, and more correct, by using a job-costing system. This also helps facilitate pricing the work, as the correct gross-up can be added in the certain knowledge that all relevant costs have been accounted for.
- Service department efficiency is enhanced – job-costing internal services also means that analysis of the efficiency of the service department is enhanced. It is much easier to compare specific charge-outs against expected standard costs than to attempt to measure efficiency using arbitrary allocations.

C. BATCH COSTING

Definitions

Batch costing is defined in the CIMA Terminology as:

> *"That form of specific order costing which applies where similar articles are manufactured in batches either for sale or for use within the undertaking.*

In most cases the costing is similar to job costing."

A batch cost is described as:

> *"Aggregated costs relative to a cost unit which consist of a group of similar articles which maintains its identity throughout one or more stages of production."*

The main point to note, therefore, is that it is a method of job costing, the main difference being that there are a number of similar items rather than just one. Batch costing will apply in similar situations to those we mentioned in job costing, i.e. general engineering, printing, foundries, etc.

Costs will be worked out in a similar fashion to job costing and then apportioned over the number of units in the batch to arrive at a unit cost.

Example

The following is an example of how batch costing operates.

The XYZ Printing Co. has received an order for printing 1,000 special prospectuses for a customer. These were processed as a batch and incurred the following costs:

- Materials – £500
- Labour – design work 150 hours at £15 per hour
  – printing/binding 10 hours at £5 per hour.

Administration overhead is 10% of factory cost.

The design department has budgeted overheads of £20,000 and budgeted activity of 10,000 hours.

The printing/binding department has budgeted overheads of £5,000 and budgeted activity of 1,000 hours.

Calculate the cost per unit.

Solution

The overhead absorption rates are as follows:

Design (£20,000/10,000)	£2 per labour hour
Printing/binding (£5,000/1,000)	£5 per labour hour.

The cost per unit can therefore be calculated as:

		£	£
Direct material			500
Direct labour:			
Design	(150 × £15)	2,250	
Printing	(10 × £5)	50	2,300
Prime Cost			2,800
Overheads:			
Design	(150 × £2)	300	
Printing	(10 × £5)	50	350
Factory Cost			3,150
Admin. cost (10% of factory cost)			315
Total Cost			3,465

As this is the total cost of the batch, we find the cost per unit simply by dividing by the number of units in the batch, i.e.:

$$\frac{£3{,}465}{1{,}000} = £3.465 \text{ per unit } (£3.47 \text{ rounded}).$$

D. CONTRACT COSTING

Contract costing is similar in some ways to job costing in that it relates to identifiable units. However, the major difference is in the scale of the relative items. Whereas job costing is applicable in the instances where an item or items may take hours or perhaps days to complete, contract costing is used for large-scale projects which may take more than one financial year to complete.

Definitions

Contract costing is defined in the CIMA Terminology as:

> *"That form of specific order costing which applies where work is undertaken to customers' special requirements and each order is of long duration (compared with those to which job costing applies). The work is usually constructional and in general the method is similar to job costing."*

A contract is defined as:

> *"Aggregated costs relative to a single contract designated a cost unit."*

Problems Associated with Contract Costing

(a) Allocating profit to different accounting periods: as already noted, longer duration contracts may start in one accounting period and end in another. One problem that this raises is the equitable apportionment of the contract's profit between the relevant accounting periods. We shall consider this point in more detail shortly.

(b) Cost control: large-scale contracts, particularly where a remote site is involved, may lead to problems of controlling costs relating to damage, pilferage, plant and machinery usage and so on.

(c) Direct cost allocation: most of the cost allocated to such contracts will be classed as direct cost rather than production overhead. This would include supervisors, plant allocation costs and so on.

Contract Costs

(a) Application and Cost Collection

Costs are collected by reference to a contract number and a separate account kept for each contract. There is also a separate account for each contractee (i.e. the customer for whom the contract is carried out).

(b) Subcontractors

In some cases there may be specialised routines which it is prudent to have performed by outside experts. These specialists are known as subcontractors, and payments to them are dealt with as direct expenses and debited to the contract account.

(c) Materials

Materials may be requisitioned from the company's own stores, in which case a materials requisition note will be issued allocating the necessary materials. This will record the cost of materials issued, which will form part of the build-up of total cost. Alternatively, materials may be delivered direct from the supplier to the contract site. In this instance the whole cost of the delivery can be allocated to the contract and the accounting department will check the goods received note against the original order before making the allocation.

(d) Direct Labour

Labour employed on site may be either direct labour, i.e. employed by the company, or subcontract labour, i.e. external labour employed only for that particular contract. Direct labour on site is usually paid on an hourly basis. It is a simple matter for the hours worked to be logged and the total labour cost for the contract to be identified.

(e) Overheads

As has already been noted, what would usually be classed as production overhead tends to be a direct cost in the case of contract costing. General administration overheads may be added at the end of each accounting period, but this should not happen if the job is unfinished at that point, because only production overhead should be carried within the work-in-progress.

(f) Plant on Site

Where plant is sent out to a particular site, the contract is charged with the **capital value of the plant**. When the plant returns from the site, it is revalued and credited to the contract; the difference is the **depreciation** charged to the contract. This procedure is also carried out at the date of the balance sheet. Alternatively, a calculated periodic charge for plant may be made. If plant is in use on several contracts, this may be on a daily basis.

(g) Retentions and Architects' Certificates

In contract work, the contractor would have serious cash flow problems if he received no payment until the contract was completed. There are usually, therefore, **stage payments** as the work proceeds. The amount to be paid is decided by an architect or surveyor, who inspects the work and issues certificates stating the value of completed work to date.

It is normal to find a clause in a contract to the effect that a percentage of the certified value may be held back by the contractee and paid to the contractor only after a suitable time-lapse following the completion of the contract – say, six or 12 months after completion. This is to protect the contractee by ensuring that the contractor will put right any defects found in the work within that time. (If he did not put right the defects, the contractee could withhold payment.) The money held back in this manner is called 'retention money'.

SSAP 9: Stocks and Long-Term Contracts

Accounting for long-term contracts is covered by SSAP 9 'Stocks and Long-Term Contracts'. This standard requires companies to account for turnover as the contract progresses and allows for attributable profit to be reflected in the profit and loss account as long as the outcome of the contract can be assessed with reasonable certainty.

Turnover should reflect the stage of completion of the contract and may be calculated by using the value certified or by expressing the costs to date as a percentage of total costs and then applying this percentage to the contract price.

Profit must be assessed on a prudent basis and will be calculated by matching the above turnover figure with its attributable costs.

The company must also assess whether the completed contract will be profitable and if it is felt that a loss will result then this fact must immediately be reflected in the profit and loss account.

SSAP 9 has standardised the balance sheet treatment of balances associated with long-term contracts. The standard states that stocks should be stated in the balance sheet at total costs incurred, net of amounts transferred to the profit and loss account in respect of work carried out to date, less foreseeable losses and applicable payments on account. It goes on to say that if turnover exceeds payments on account an amount recoverable on contracts is established and separately disclosed within debtors. Payments on account in excess of reported turnover will be shown as a deduction in stock values but it should be noted that stock cannot go negative which in turn requires any excess to be shown as part of creditors.

E. PROCESS COSTING

General Principles

The CIMA Official Terminology defines process costing as:

> *"The basic costing method applicable where goods or services result from a sequence of continuous or repetitive operations or processes to which costs are charged before being averaged over the units produced during the period."*

This method of costing applies not only to the areas mentioned above, but may also be used in situations of continuous production of large numbers of low cost items such as tin cans or light bulbs.

Diagrammatically, process costing can be represented as follows:

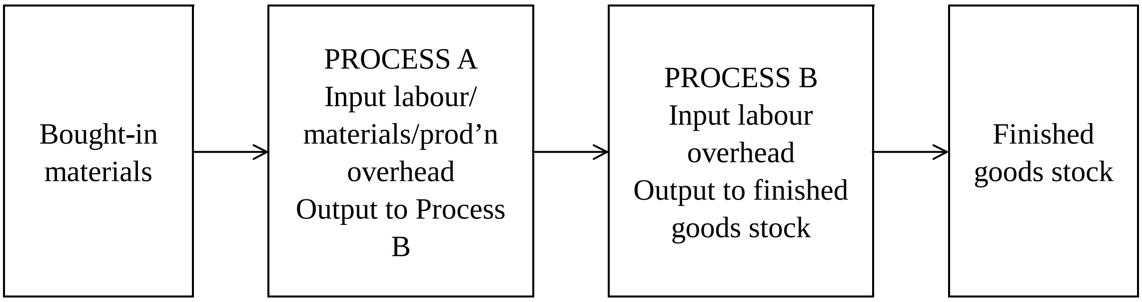

Figure 7.1: Process Costing

Production is moved from process to process and the costs are transferred with it so that it is the cumulative cost that is carried to finished goods stock.

In accounting terms the costs are built up as follows:

PROCESS A			
	£		£
Labour	5,000	Transferred to Process B	10,000
Materials	4,000		
Overheads	1,000		
	10,000		10,000

PROCESS B			
	£		£
Transferred from Process A	10,000	Transferred to finished goods stock	18,000
Labour	3,000		
Materials	4,000		
Overheads	1,000		
	18,000		18,000

FINISHED GOODS STOCK			
	£		£
Transferred from Process B	18,000		
	18,000		

Comparison of Job and Process Costing

Job	Process
Items are discrete and identifiable.	Items are homogeneous.
Costs are allocated to individual units of production.	No attempt is made to allocate costs on an individual basis.
Losses are not generally expected to occur in the course of production.	Losses are expected to occur (see later).
As costs are allocated to each unit, each item of finished production has its own costs.	As costs are allocated to the process, finished goods have an average value.
Stock consists of unlike units.	Stock consists of like units.
Direct costs (labour, materials and product overhead) are the same under both systems.	

Method of Process Costing

(a) The method is essentially one of **averaging**, whereby the total costs of production are accumulated under the headings of processes in the manufacturing routine, and output figures are collected in respect of the various processes. The total process cost is divided by the total output of the process, so that an **average unit cost of manufacturing** is arrived at for each process.

(b) Where there are several processes involved in the production routine, it is normal to cost each process, and to build up the final total average cost step by step. The output of one process may be the raw material of a subsequent one, thus making it necessary to establish the process cost at each stage of the manufacturing operation.

(c) Each process carried out is regarded as a **cost centre**, and information is collected on the usage of materials, costs of labour and direct expenses exclusively attributable to individual processes. Each process, in an absorption costing system, will be charged with its share of overhead expenses. This principle is assumed to be in operation throughout this study unit.

(d) We have stated that an average cost per unit is obtained for each process. This average cost is arrived at by dividing the cost of each process by the number of good units of production obtained from it. Hence, it is necessary to set up a **report scheme** to find the number of units produced by each process. Since it is unlikely that all material entering a process will emerge in the form of good production, the recording scheme should provide records of **scrap** from each process, in addition to records of good production achieved. These records should, if possible, be kept by clerks, rather than by foremen who are preoccupied by production problems.

Material Usage

(a) The method of charging material usage will depend on the factory layout and organisation. If there is only one injection of raw material at the stage of the initial process, the problem is simplified, and material usage can be computed from the stores requisition slips. In this case, the output of the first process becomes the raw material of the second, and so on.

(b) If further raw material is required in a subsequent process, it may be convenient to establish new material stores adjacent to the point of usage, and record the usage from the stores requisition slips.

(c) In many cases, material may be used which is of little value unit-wise (e.g. nails) and the volume of paperwork required to record each issue would be prohibitive. In such cases, the method of charging would be to issue the anticipated usage for a costing period at one time, the issue being held for use at the point of manufacture. A physical stocktaking at the end of the period would establish actual usage of material, which could be compared with the theoretical usage expected for the output achieved.

Accounting for Labour

Accounting for labour where process costing is in operation is, normally, straightforward. Fixed teams of operatives are associated with individual processes, and the interchange of labour between processes is not encouraged from the point of view of efficiency. It is often as simple as collating names on the pay sheets to establish the wages cost for a process. Where process labour is interchangeable, labour charges per process may be established by issuing **job cards** to employees, to record the time spent on each process.

Direct Expenses

All expenses wholly and exclusively expended for one particular process will be given the proper process number and allotted to the cost centre on this basis.

Overhead Expenses

In absorption costing, the indirect material, labour and expenses not chargeable to one particular process must be borne, eventually, by production. Absorption rates are used as before, and we need to establish rates in advance for **each of our cost centres**. This means that the total overhead expenses of the business must be estimated and allocated or apportioned to the processes, in terms of the rules which we have already explained. As we have seen, it is necessary to assess the output expected at each cost centre. Then, the absorption rates for the cost centres can be calculated by dividing the estimated costs associated with them by the estimated output per cost centre.

In this way, we establish a relationship between overhead cost and activity and, at the close of each period, the actual activity achieved by the cost centre is multiplied by the predetermined rate, to give the charge for overheads.

F. TREATMENT OF PROCESS LOSSES

Normal Wastage

All waste, theoretically, is avoidable, and it can be said that inefficiency exists wherever waste occurs. However, no factory can avoid producing some waste, and every effort must be made to reduce it to an absolute minimum, by the proper use of materials, machines or methods. Processing operations are particularly prone to losses through evaporation, spillage or rejection of substandard output. How should such losses be costed?

One method is to assume that the losses have no cost and the unit is based on the actual number of units produced. Assume we have a process which incurs process costs of £350,247 for an input of 1,000 litres. What would the unit cost be if output was (a) 850 litres or (b) 950 litres?

(a) $\frac{£350{,}247}{850}$ = £412.06 per litre unit cost

(b) $\frac{£350{,}247}{950}$ = £368.68 per litre unit cost

The problem with this approach is that the unit cost will fluctuate from period to period making it difficult to plan forward, particularly if the level of wastage varies widely from period to period. Alternatively, the average loss over a period of time could be used as a basis for calculating average unit cost, say on a weekly or monthly basis.

A second method is to assume that losses do have a cost which should be accounted for. In this instance the cost per unit is based on units of input rather than units of output. Referring back to our previous example:

At output of 850 litres

Cost per unit	=	$\frac{£350{,}247}{1{,}000}$	=	£350.25 per litre
Total cost of output	=	£350.25 × 850	=	£297,710
Total cost of loss	=	£350.25 × 150	=	£52,537

At output of 950 litres

Cost per unit	=	£350.25 (as above)		
Total cost of output	=	£350.25 × 950	=	£332,735
Total cost of loss	=	£350.25 × 50	=	£17,512

All such losses incurred would be written off to the profit and loss account. The problem with this method is that some cost of production may be unnecessarily written off if some process losses are unavoidable.

The third and most widely used method attempts to allow for the fact that some loss is inevitable. Such loss is not given any cost but any wastage over and above this is called **abnormal loss** and is given a cost. Any loss under that which is expected is called **abnormal gain**, the value of which is debited to the process account.

The normal waste in processes can be expressed as a percentage of the total input of material. The cost of normal wastage is borne by the process, less any incoming credit in respect of the sale of waste.

Specimen Process Waste Accounts

Consider the following information:

Cost of process	£2,000
No. of units entering process	1,000
Percentage of input regarded as normal waste	10%
Value of waste per unit	25p

The process account will then be as follows:

PROCESS ACCOUNT

	Units	£		Units	£
Input in units	1,000		Normal waste	100	25
Cost of process		2,000	Cost of normal output	900	1,975
	1,000	2,000		1,000	2,000

Calculations

(a) Normal waste – 10% of input = 100 units

(b) Credit value of (a) above, 100 units at 25p per unit = £25

(c) Cost of normal output per unit = $\frac{£2{,}000 - 25}{900}$ = £2.19

It will be seen that the cost of normal waste is written into the cost of good production but that credit is given for its scrap value, if any.

Abnormal Loss or Gain

As we have seen, if wastage is greater than normal, there is said to be an abnormal loss, while if wastage is less than normal there is an abnormal gain. Normal waste is treated in exactly the same manner as above – i.e. its scrap value is credited to the process account and the cost per unit of normal output is found. Abnormal losses or gains are valued at the same value as good production, and transferred to the abnormal loss or gain account, and thence to the profit and loss account, after making any adjustments for the income from the sale of abnormal loss.

Specimen Abnormal Loss Process Accounts

Consider the following information:

Total cost of process = £7,385

No. of units input = 700

Normal loss = 5% of input

Actual loss = 40 units

Scrapped units are sold at £2 each.

Produce the process account, abnormal loss account and scrap account.

Workings

Normal loss: 5% of 700 = 35 units

Scrap value of normal loss = 35 × £2 = £70

Actual loss = 40 units

Therefore, abnormal loss = 5 units

Normal output expected = 700 – 35 = 665 units

Therefore, cost per unit of normal output $= \dfrac{£(7{,}385 - 70)}{665}$

(allowing credit for scrap value of normal loss)

= £11 per unit

i.e. abnormal loss and good production are each valued at £11/unit.

Therefore, cost of abnormal loss = 5 × £11 = £55

Therefore, cost of good production = 660 × £11 = £7,260

PROCESS I ACCOUNT

	Units	£		*Units*	£
Input	700	7,385	Normal loss (scrap value)	35	70
			Process II	660	7,260
			Abnormal loss	5	55
	700	7,385		700	7,385

ABNORMAL LOSS ACCOUNT

	£		£
Process I *(see note (a))*	55	Scrap *(see note (b))*	10
		Profit and loss a/c *(see note (c))*	45
	55		55

SCRAP ACCOUNT

	£		£
Abnormal loss *(see note (b))*	10	Cash *(see note (e))*	80
Process I – normal loss *(see note (d))*	70		
	80		80

Notes on Abnormal Loss Account and Scrap Account

(a) This is the double entry of the abnormal loss appearing in the process account.

(b) These are the two halves of a double entry, and they represent the scrap value of abnormal loss (5 units @ £2).

(c) This is the loss to be transferred to profit and loss account, arising from the abnormal loss. It is found as the balancing figure on the account.

(d) This is the double entry of the normal loss entry in the process account.

(e) This is the cash which would be received from sale of both normal and abnormal loss (40 units @ £2).

G. WORK-IN-PROGRESS VALUATION

One of the difficulties that arises with process costing is the valuation of work-in-progress. This is because costs need to be apportioned fairly over the units of production which, as you are now aware, are not generally separately identifiable. Materials may be added in full at the start, or at varying rates through the differing processes; the cost of labour may not necessarily be incurred in proportion to the level of output achieved.

In order to apportion costs fairly, the concept of equivalent units is used. The CIMA Official Terminology defines them as:

> *"A notional quantity of completed units substituted for an actual quantity of incomplete physical units in progress, when the aggregate work content of the incomplete units is deemed to be equivalent to that of the substituted quantity of completed units, e.g. 150 units 50% complete = 75 units.*
>
> *The principle applies when operation costs are being apportioned between work-in-progress and completed output."*

Example – Valuing WIP Using Equivalent Units

"Paint by Numbers" Ltd is a paint manufacturing company which produces a range of different paint products. The production of "vinyl silk" paint requires two different processes.

In process I the costs incurred during January were:

	£000
Materials	2,000
Labour	2,700
Overhead	1,600
	£6,300

There was no opening work-in-progress. 1,100,000 litres were introduced into the process. 700,000 were completed during January and transferred to process II. The remaining 400,000 were:

%	
75	complete as to materials
50	complete as to labour
25	complete as to overhead

Calculate: cost per unit; total value of finished production; value of closing work-in-progress.

Draw up the process account.

Answer

The idea of equivalent units is that 200 units half complete are equivalent to 100 units fully complete, in terms of cost. In the above example, we have different degrees of completion for the different elements of cost – units comprising the closing WIP have had 75% of the required material incorporated in them. This has taken 50% of the labour processing time necessary to complete a full unit; and the overhead content is put at 25% of that for a full unit (e.g. the units concerned have had 25% of the necessary machine time).

Since there is no mention of overhead absorption rates in this question, we assume that overhead is charged to production **as it is actually incurred**, rather than by the use of predetermined absorption rates.

Valuations:

Total cost per equivalent unit = £7 (see Table 7.1)

Value of finished production = £7 × 700,000 = £4,900,000

Value of closing WIP (ascertained by reference to no. of equivalent units for each category of cost):

		£	*£000*
Material	(75% × 400,000)	300,000 × 2 =	600
Labour	(50% × 400,000)	200,000 × 3 =	600
Overhead	(25% × 400,000)	100,000 × 2 =	200
			£1,400

PROCESS I ACCOUNT

	Units	*£*		*Units*	*£*
Material	1,100,000	2,000	Process II	700,000	4,900
Labour		2,700	WIP c/d	400,000	1,400
Overhead		1,600			
	1,100,000	6,300		1,100,000	6,300
WIP b/d	400,000	1,400			

Table 7.1: Calculation of Equivalent Units and Cost per Unit

	Material		**Labour**		**Overhead**	
	% Completion	***Equivalent Units***	***% Completion***	***Equivalent Units***	***% Completion***	***Equivalent Units***
Completed units transferred to next process	100	700,000	100	700,000	100	700,000
WIP c/d (400,000)	75	300,000	50	200,000	25	100,000
Total equivalent units (a)		1,000,000		900,000		800,000
Costs incurred, *£000* (b)		2,000		2,700		1,600
Cost per equivalent unit £ ((b) ÷ (a))		2		3		2

It should be noted that the **Equivalent Units** technique relates to partially completed items at a satisfactory state of partial completion. It sometimes happens that during the processes, some items regarded as partially complete become, for whatever reason, faulty and useless as potentials for sale. In this event it is usual to calculate two figures for total units. For example:

Using the weighted average method:

Opening Stock	32,000
Units started during current period	164,000
Total units	196,000

and also:

Units completed & transferred out	160,000
Units in closing WIP stock	24,000
Total units accounted for	184,000

Therefore, 12,000 spoilt during processing.

By dividing the total material and conversion costs by the different figures (196,000 and 184,000), different unit costs can be determined.

The cost of the faulty units will be the number of faulty units (12,000) multiplied by the unit cost figure from the calculation using the 184,000 divisor. The additional process cost becomes the number of faulty units (12,000) multiplied by the difference between the two different unit cost figures. This method is often referred to as the "**method of neglect**".

This method of neglect does not encourage managers to decrease the number of faulty units, because exclusion of faulty units does not make them accountable, as they are excluded from the EUP calculation.

H. JOINT PRODUCTS AND BY-PRODUCTS

Joint Products

Where two or more products emerge from a process in such proportions that neither can be termed the main product, they are known as joint products. The problem which arises here is to apportion the expenses of the joint process to the individual products. These joint products may be either different commodities unavoidably produced (such as fuel oil and petrol, mutton and wool), or different grades of the same product (such as coal raised from a mine).

Split-off Point

The point at which individual products can be identified and costed separately is known as the split-off point. Up to this stage, the costs incurred are **common to all units produced** and their allocation to products must, necessarily, be arbitrary.

Apportioning Costs Incurred

The following methods are used for apportioning costs incurred up to the separation stage:

(a) Physical Measurement

If a load of coal is raised, comprising two grades – 80 tons of grade A and 20 tons of grade B – the costs of raising the full load may be apportioned 80% to A and 20% to B. This method is unsuitable if the market value varies considerably, or if there is no **common basis of measurement** – e.g. if one product is a solid and the other a gas.

(b) Market Value at Separation Point

Under this method the joint products are valued at market value, and the relationship emerging is the basis on which the process cost is allocated to the joint products.

For example, the process cost of producing A and B is £140 and the market values at point of separation are A: £100, B: £75.

Thus, the relationship to be used to split the process cost is A: 4 and B: 3. The total process cost is thus split A: £80 and B: £60.

This method cannot be used if there is no market value at separation point (i.e. the products cannot be sold without further processing), or if the costs of further processing are disproportionate.

(c) Reversion From Sales Price

In this method we work back from the selling prices of the joint products to obtain the relationship to split the process costs.

For example, two joint products, X and Y, have selling prices of £300 and £400, respectively. We have estimated that the costs incurred after separation amount to £40 for X and £50 for Y. The process costs of the joint products were £200. The profit margins, expressed as percentages of selling price, are X, 10% and Y, 20%.

	Product X	Product Y
	£	£
Sales value	300	400
less Profit	30	80
	270	320
less Costs after separation	40	50
	£230	£270

The joint process cost of £200 is allocatedas follows:

$$\frac{230}{500} \times £200 \text{ to X and } \frac{270}{500} \times £200 \text{ to Y.}$$

The actual figures are £92 and £108, respectively.

Note: If the profit percentage is not known, it is an acceptable approximation to use simply sales values **less** the post-separation costs.

By-Products

These are items which are, in themselves, of little value (relative to the main product) which are unavoidably produced in the course of producing the main product. Often, by-products can be regarded as **waste**, and sold as such, with the amount realised being credited to the main process account. If further processing will give a reasonable return, however, a sub-process will be carried out. It is usual, in this case, to credit the main process account with the sales value of the by-product, **less** the cost of further processing. Alternatively, the amount realised from sales of the by-product, **less** the cost of further processing, may be credited directly to the profit and loss account.

Example: Joint and By-Products

From a single raw material, a chemical company makes three products – A, B and C. Product A is considered to be a by-product. Products B and C are treated as major joint products.

In process I, by-product A is obtained, and the remaining output passes to process II, where products B and C are obtained.

During the month, materials cost £7,200.

Operating expenses were:	process I	£12,000
	process II	£15,000

Work-in-progress was negligible at both the beginning and end of the month.

Production and sales were as follows:

Product	Production	Sales	
A	12,000 gallons	6,000 gallons	@ 5p per gallon
B	18,000 tons	15,000 tons	@ £2 per ton
C	5,000 tons	3,000 tons	@ £4.80 per ton

Initial stocks were:

A 1,200 gallons at 5p per gallon

B 1,500 tons at £1.50 per ton

C 100 tons at £3.75 per ton

Required information:

(a) Stock valuation (using weighted price for B and C, market price for A).

(b) Statement of gross profit.

Answer

In this question there are two matters about which we must make a decision before we start any calculations:

- ***Treatment of By-product A***

  In this case we shall credit the main process account with the sales value of the product, and maintain a product A stock account at market value. There will be no profit shown on product A, the income from which reduces the cost of the two main joint products.

- ***Allocation of Joint Cost***

  Costs up to separation point are allocated between B and C, in relationship to the sales value of the products:

  (i) Statement of Net Joint Cost

		£
Process I	Raw materials	7,200
	Operating expenses	12,000
		19,200
	less Market value of by-product 12,000 gallons @ 5p per gallon	600
		18,600
Process II	Operating expenses	15,000
	Net joint product costs	£33,600

(ii) *Basis of Joint Cost Allocation*

	£
Production of product B valued at SP 18,000 tons @ £2 per ton	36,000
Production of product C valued at SP 5,000 tons @ £4.80 per ton	24,000
Basis of allocation of joint cost:	
Product B: 3/5 × £33,600	20,160
Product C: 2/5 × £33,600	13,440
	£33,600

(iii) *Calculation of Stock Values and Cost of Sales*

	Product B		**Product C**	
	Units	**Value**	**Units**	**Value**
		£		£
Opening stock	1,500	2,250	100	375
add Production	18,000	20,160	5,000	13,440
	19,500	22,410	5,100	13,815
Sales	15,000		3,000	
Closing stock	4,500		2,100	

	Product B		**Product C**	
Stock valued at weighted price	$\frac{22,410}{19,500} \times 4,500$	£5,172	$\frac{13,815}{5,100} \times 2,100$	£5,689
Cost of sales valued at weighted price	$\frac{22,410}{19,500} \times 15,000$	£17,238	$\frac{13,815}{5,100} \times 3,000$	£8,126
		£22,410		£13,815

	Product A	
	Units	**Value** £
Opening stocks	1,200	60
add Production	12,000	600
	13,200	660
less Sales	6,000	300
Closing stocks	7,200	£360

Hence, the solution of part (a) of the problem is:

Stock valuations

Product	£
A	360
B	5,172
C	5,689

(iv) Calculation of Gross Profit

		£
Sales		
Product A (6,000 gallons at 5p per gallon)		300
Product B (15,000 tons at £2 per ton)		30,000
Product C (3,000 tons at £4.80 per ton)		14,400
		44,700
Cost of Sales		
Product A – as per (iii) above	300	
Product B – as per (iii) above	17,238	
Product C – as per (iii) above	8,126	25,664
Gross profit		£19,036

I. OTHER PROCESS COSTING CONSIDERATIONS

Limitations of Joint Cost Allocations

The allocation of common costs to joint products is necessary for stock valuation purposes and profit measurement. For decision-making, these allocations have little or no relevance. Costs and income beyond split-off point are the key factors in decisions. The application of incremental costs to further processing decisions will be considered further in a later study unit.

Defective Units and Reworking

Where units do not meet the standards of quality laid down, they may either be sold at reduced prices as ‘seconds’ or reworked, to bring them to the required standard.

The advisability of reworking defective units must depend on the cost of rectification compared with the increase in unit value. If an item can be sold for £50 without reworking or can be sold for £100 by incurring a reworking cost of £40, then, clearly, the reworking is justified. The cost of reworking is usually charged to factory overheads, and it is, thus, spread over all units. Reports to the management on reworking and rectification costs should be made on a routine basis.

Study Unit 8

Cost-Volume-Profit Analysis

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INTRODUCTION

This study unit marks the start of the work we shall be doing on the area of decision making.

We considered the use of variable costing methods in an earlier study unit and we noted that some costs are of a **variable** nature (according to the volume of output), while others are **fixed** and remain unaltered within limits of output. In this study unit we shall consider the significance of cost behaviour and its relation to break-even analysis and information for decision making.

A. THE CONCEPT OF BREAK-EVEN ANALYSIS

The terms cost-volume-profit (CVP) and break-even (B/E) analysis are interchangeable for the purposes of our work here. The B/E point is that at which the firm makes neither a profit nor a loss and can be expressed as either the sales value required or the number of units to be sold. There are a number of important elements within the framework of B/E analysis as follows.

Cost Equations

The difference between sales and variable cost is known as the **contribution**. This shows the amount available to meet fixed costs and to contribute towards profit. The equation to express these relationships is:

$$S - V = F + P$$

where: S = Sales

V = Variable cost

F = Fixed cost

P = Profit

Example

To illustrate the arithmetic, consider the following simple example:

Sales value:	£5 per unit
Variable costs:	£2 per unit
Fixed costs:	£30,000

Compute the B/E point.

Using the above formula, we need to calculate how many units we require to sell so that

$$S = V + F$$

and therefore no profit or loss is made. Firstly we need to calculate the contribution per unit which in this instance is £3 (sales value £5 less variable costs per unit of £2). Next we must determine how many contributions of £3 are needed to cover our fixed costs of £30,000, i.e.

$$\frac{F}{S - V} = \frac{\pounds 30{,}000}{\pounds 3} = 10{,}000 \text{ units.}$$

The profit and loss account will show the following:

	£
Sales (10,000 × £5)	50,000
Variable cost (10,000 × £2)	(20,000)
Fixed cost	(30,000)
Profit	–

If we were to sell one extra unit, the figures would change to:

	£
Sales (10,001 × £5)	50,005
Variable cost (10,001 × £2)	(20,002)
Fixed cost	(30,000)
Profit	3

Contribution to Sales (C/S) Ratio

This is an important ratio and is also known as the profit/volume (P/V) ratio. It is an alternative way of expressing the break-even point in terms of sales revenue. The formula for the C/S ratio is:

$$\frac{S - V}{S}$$

In the above example, this would be:

$$\frac{5 - 2}{5} = 60\%$$

Put another way, 60% of the sales value of each item is the contribution towards fixed cost and profit. The calculation of the break-even point using this calculation is:

$$\text{Sales revenue at break-even point} = \frac{F}{C/S}$$

In our example, this is:

$$\frac{£30{,}000}{60\%} = £50{,}000$$

This is the same figure that we calculated earlier.

Margin of Safety

The margin of safety is the amount by which the expected level of sales exceeds the break-even level of sales. It may be expressed as a percentage of the budget sales volume. In our previous example, if budgeted sales had been 11,000 units then the margin of safety would be 11,000 – 10,000 = 1,000 units.

Knowledge of the size of the margin of safety is important information for management to be aware of; once it is known, decisions can be taken on, in particular, pricing and production levels which may otherwise be subject to uncertainty. Taking our example further, if the company had the potential of gaining an order in addition to the expected level of sales, it could afford to lower the price in the knowledge that fixed costs should already be covered by existing volumes.

We shall expand on this theme of using information for decision-making purposes in the next unit.

Target Profits

In addition to calculating the break-even level of sales, a company can set itself a target to achieve a certain level of profits. This is again based on the concept of contribution and can be expressed as:

Contribution required = F + P

where: P is the required profit.

Example

Petal Plastics make and sell a particular item, the details of which are as follows:

	£
Direct material per unit	11
Direct labour per unit	7
Variable production overhead per unit	2
Selling price per unit	35

Fixed costs are £45,000 in total. If the company wishes to make a profit of £30,000 per annum, what sales level will be required?

The contribution required is F + P, which in this instance will be £45,000 + £30,000 = £75,000. Required sales therefore is:

$$\frac{\text{Required contribution}}{\text{Contribution per unit}}$$

Contribution per unit is £35 – £11 – £7 – £2 = £15, so that

$$\text{Sales level required} = \frac{£75{,}000}{£15} = 5{,}000 \text{ units}$$

Proof:

	£
Sales (5,000 × £35)	175,000
less Variable cost (5,000 × £20)	100,000
Contribution	75,000
less Fixed costs	45,000
Profit	30,000

The alternative way to calculate the required level of sales is using the C/S ratio, which is:

$$\text{C/S ratio} = \frac{£35 - £20}{£35} = 42.86\%$$

$$\text{Sales revenue required} = \frac{\text{Required contribution}}{\text{C/S ratio}}$$

$$= \frac{£75{,}000}{42.86\%} = £175{,}000$$

Effect of Changes in Selling Price or Costs

(a) Selling Price Changes

The analysis can also be used to ascertain the effect of changes in the parameters on the level of sales value or volume required. For instance, take the example of Petal Plastics again; suppose that the management consider that a reduction in sales price will lead to an increase in the level of sales. What they need to know is whether the increased volumes at this lower price will provide more profit.

The management considers that reducing the selling price to £30 will produce more sales; what is the level of sales required to maintain current profit levels?

In this scenario, all parameters are unchanged apart from the sales value. The new contribution level per unit is therefore £10, so to maintain profit of £30,000:

$$\text{Sales volume required} = \frac{£75{,}000}{£10} = 7{,}500 \text{ units}$$

Proof:

	£
Sales (7,500 × £30)	225,000
less Variable cost (7,500 × £20)	150,000
Contribution	75,000
less Fixed cost	45,000
Profit	30,000

What management must now decide is whether a reduction in sales price of approximately 14% (5/35) will produce increased sales volume of 50%, i.e.:

$$\frac{(7{,}500 - 5{,}000)}{5{,}000}.$$

(b) Cost Changes

Changes in the variable costs of production can also give rise to management decisions similar to those arising from changes in sales values. These decisions usually arise as a result of the change in the relationship between fixed and variable costs.

Example

Petal Plastics is considering automating part of its production process, which it is envisaged will result in variable costs falling to £15 per unit, but fixed costs will increase to £67,500 per annum due to increased hire charges and machine servicing costs. How many units must be sold to maintain the profit level? What will the profit be at the original production target of 5,000 units per annum and what is the new B/E point?

With variable costs at £15 per unit and assuming sales values remain at £35, the new level of contribution per unit is £20. Our target contribution is now £97,500 (fixed costs of £67,500 plus intended profit of £30,000). Sales volume to maintain the level of profit is therefore:

$$\frac{£97{,}500}{£20} = 4{,}875 \text{ units}$$

This shows that the decision to automate is the correct one, because profit will be maintained even though 125 units less are sold. If sales volume is kept at 5,000 units, the profit will be:

	£
Contribution (5,000 × £20)	100,000
less Fixed costs	67,500
Profit	32,500

which is an increase of £2,500. Another way of calculating this is to take the full contribution on the additional units, i.e. 125 × £20 = £2,500. This is because our target contribution is already covered by selling 4,875 units; any sales over this and the full contribution is an addition to profit.

The revised B/E point is as follows:

$$\text{B/E} = \frac{\text{Fixed costs}}{\text{Contribution per unit}}$$

$$= \frac{£67{,}500}{£20} = 3{,}375 \text{ units}$$

B. BREAK-EVEN CHARTS (COST-VOLUME-PROFIT CHARTS)

An alternative to calculating the B/E point is to show the results graphically using what is known as a B/E chart.

The CIMA definition of such a chart is:

> *"A chart which indicates approximate profit or loss at different levels of sales volume within a limited range."*

The vertical axis of the chart is for sales revenue and costs; the horizontal axis is for volume of activity (i.e. output). Three lines are then drawn on the chart as follows:

- Sales, which begins at zero and represents the linear relationships between value and volume (i.e. 1 unit = £10, 10 units = £100 and so on).

- Fixed cost – this is a line drawn parallel to the horizontal axis which cuts the vertical axis at the point which represents the total value of the fixed costs.
- Total cost – again this shows a linear relationship and begins at the point where the fixed cost line meets the vertical axis.

Where the sales and total cost lines intersect, this is the B/E point. We shall now examine these charts and the information they provide in more detail. Please note that you are not required to be able to produce them in the examination, but the ability to draw a rough sketch to emphasise a point may be useful.

Information Required

(a) Sales Revenue

When we are drawing a break-even chart for a single product, it is a simple matter to calculate the **total sales revenue** which would be received at various outputs. Let us take the following figures:

Output *units*	**Sales Revenue** *£*
0	0
2,500	10,000
5,000	20,000
7,500	30,000
10,000	40,000

We then need data on fixed and variable costs, before we can draw a break-even graph or chart.

(b) Fixed Costs

Overhead costs may sometimes have a fixed and a variable element – semi-fixed or semi-variable overheads. Let us assume that the fixed expenses total £8,000.

(c) Variable Costs

The variable elements of cost must also be assessed at varying levels of output:

Output *units*	**Sales Revenue** *£*
0	0
2,500	5,000
5,000	10,000
7,500	15,000
10,000	20,000

Plotting the Graph

When tackling this type of question I suggest you always convert the data into the following standard format which provides all the figures needed to prepare break-even charts.

	£
Sales	40,000
less Variable cost	20,000
Contribution	20,000
less Fixed costs	8,000
Profit	12,000

The graph can now be drawn to cover the sales range of 0 units up to 10,000 units. (See Figure 8.1.)

- ***Sales***

  The sales line will start at 0 units, £0 and increase to 10,000 units, £40,000.

- ***Fixed Costs***

  This is constant at £8,000 and is drawn parallel to the horizontal axis.

- ***Total Cost***

  Even if no units are sold the company will still incur fixed overheads of £8,000. When 10,000 units are sold, the company will incur costs of £28,000 being the addition of its fixed and variable costs. The total cost line therefore starts at 0 units, £8,000 and increases to 10,000 units, £28,000.

Note that, although we have information available for four levels of output besides zero, one level is sufficient to draw the chart, provided we can assume that sales and costs will lie on straight lines. We can plot the single revenue point and join it to the origin (the point where there is no output and, therefore, no revenue). We can plot the single cost point and join it to the point where output is zero and total cost = fixed cost.

In this case, the break-even point is at 4,000 units, or a revenue of £16,000.

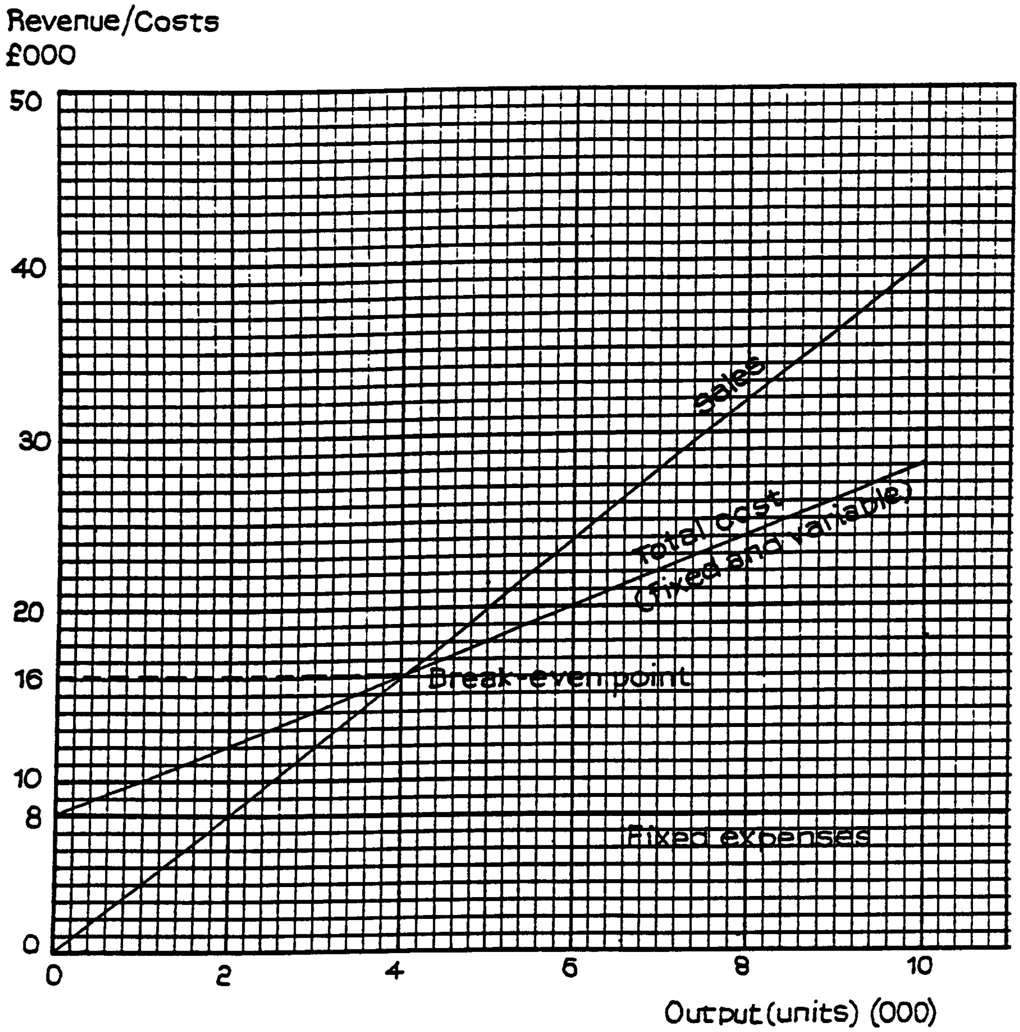

Figure 8.1: Break-Even Chart (Cost-Volume-Profit Chart)

Break-Even Chart for More than One Product

You will have noticed that a break-even chart can be drawn only for a single product, because of the assumptions of constant unit costs and revenues. It **is** possible to draw a break-even chart for more than one product, if we can assume a **constant** product mix. Even so, the break-even chart is not a very satisfactory form of presentation when we are concerned with more than one product; a better graph – the profit/volume graph – is discussed later.

Assumptions and Limitations of Break-Even Charts

Apart from the above point about the difficulty of catering for more than one product, the following limitations should be borne in mind.

- Break-even charts are accurate only within fairly narrow levels of output. It is unwise to extrapolate beyond the known range of data. This is because if there were a substantial change in the level of output, the **proportion of fixed costs** could change.
- Even with only one product, the income line may not be straight. A straight line implies that the manufacturer can sell any volume he likes at the same price. This may well be untrue: if he wishes to sell more units, he might have to reduce the price. Whether this increases or

decreases his total income depends on the elasticity of demand for the product. Therefore, the sales line may curve upwards or downwards – but, in practice, is **unlikely to be straight**.

- Similarly, we have assumed that variable costs have a straight-line relationship with level of output, i.e. variable costs vary directly with output. This might not be true. For instance, the effect of **diminishing returns** might cause variable costs to increase beyond a certain level of output.
- Break-even charts hold good only for a **limited time-span**.
- Break-even charts assume that **sales and production are matched**. This may not be so, and there may be a change in stocks which would affect profits if absorption costing is used.

Nevertheless, within these limitations a break-even chart can be a very useful tool. Managers who are not well versed in accountancy will probably find it easier to understand a break-even chart than a calculation showing the break-even point.

Interpretation of Break-Even Charts

The skeleton break-even chart in Figure 8.2 illustrates the margin of safety and angle of incidence.

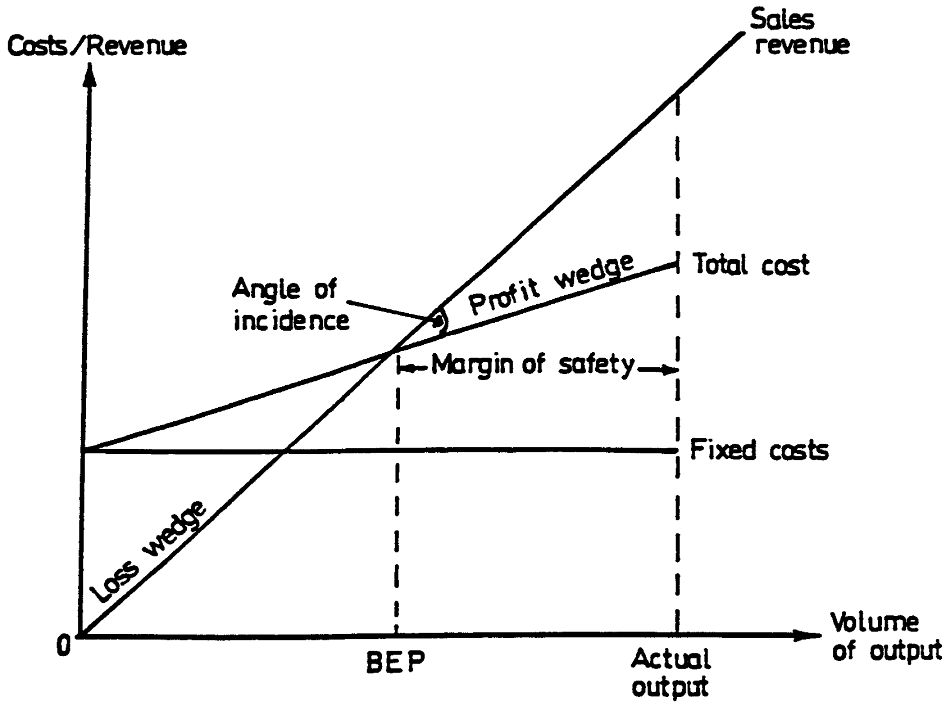

Figure 8.2: Skeleton Break-Even Chart

(a) Margin of Safety

- ***Safety of Profit Level***

  The margin of safety is a measure of how far sales can fall before a loss is incurred. This can be easily read from a break-even chart, and it gives managers an idea of how 'safe' the profit level is – the larger the margin of safety, the less risk of incurring a loss if the sales volume is allowed to fall.

  From Figure 8.2, you will see that the margin of safety is the difference between the actual output being achieved and the break-even point.

- ***Expressing Margin of Safety***

  In Figure 8.1, the company had an actual output of 10,000 units and a break-even point of 4,000 units. Margin of safety may be expressed in any of the following ways:

  Margin of safety = 4,000 to 10,000 units, or

  = £16,000 sales to £40,000 sales, or

  = 40% to 100% of actual output, or

  = sales may fall by 60% before reaching break-even.

(b) Angle of Incidence

The angle of incidence shows the rate at which profits increase once the break-even point is passed. A large angle of incidence means a high rate of earning (also, it means that, if sales fell below break-even point, the loss would increase rapidly). This is also illustrated by the size of the profit and loss wedges.

Changes in Cost Structure

If costs increase, the break-even point will be reached at a higher level of sales. The break-even chart in Figure 8.3 illustrates the effect of such changes.

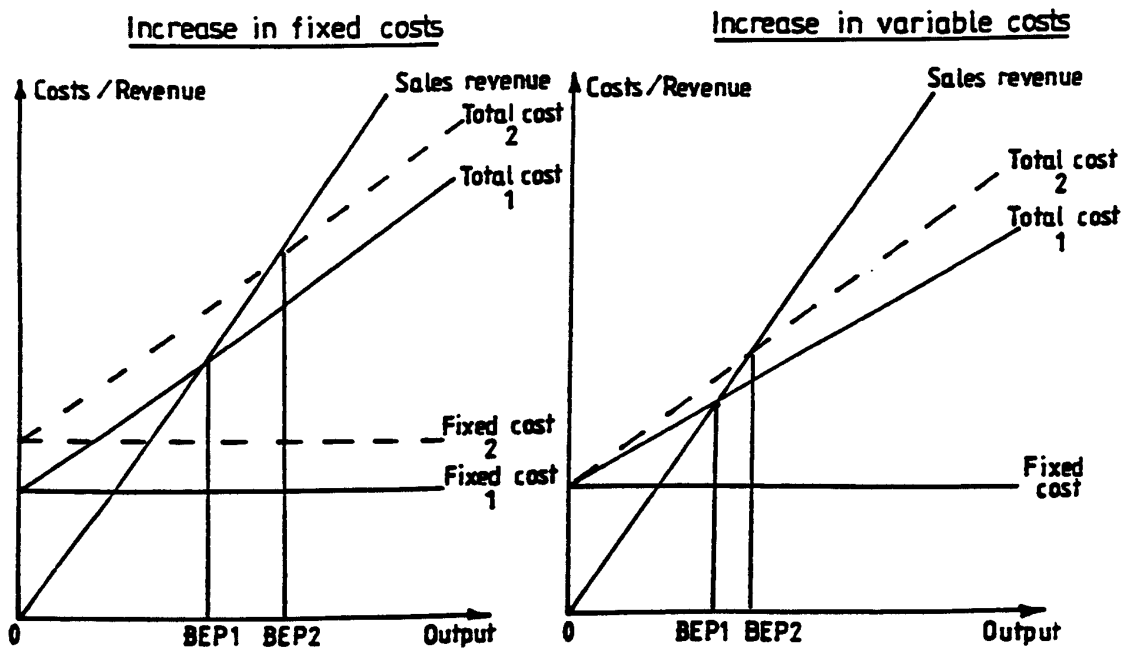

Figure 8.3: Break-Even Chart and Cost Structure

Extending Beyond the Known Range of Activity

We have already mentioned that it is unwise to extrapolate beyond the known range of data with break-even charts. A common error is to assume that, once break-even point has been passed, then any increase in output must lead to an increase in profit. This may not be so – a second break-even point may be reached, beyond which losses will be incurred. Figure 8.4 will help to demonstrate this:

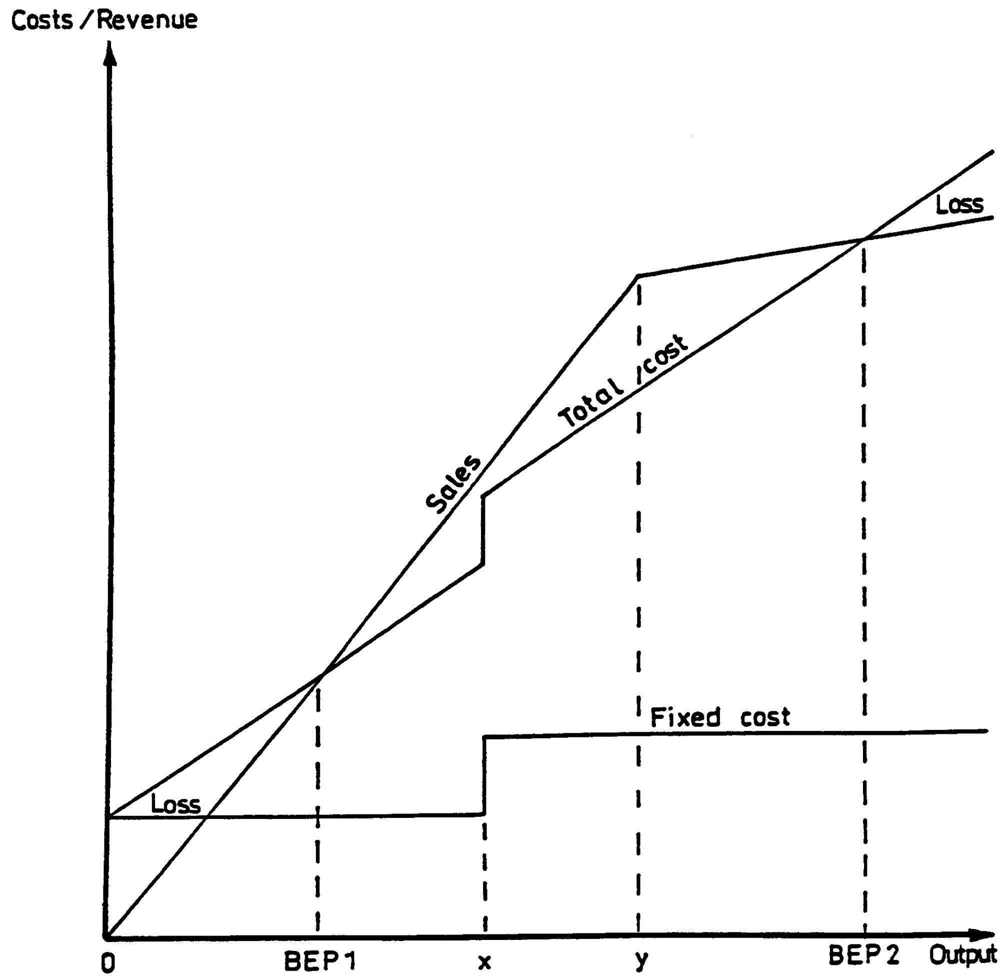

Figure 8.4: Second Break-Even Point

- The first break-even point occurs at BEP1 but it would be wrong to assume that a profit will be made at **any** output above this level, because of the cost-behaviour patterns.
- At a level of output x, there is a step in the fixed costs (perhaps owing to an extra supervisor's salary), causing a corresponding step in the total cost line.
- At a level of output y, the angle of the sales line reduces sharply, possibly indicating that a discount is necessary to achieve the higher sales volume.
- A second point, BEP2, is reached, beyond which total costs exceed sales and, therefore, the assumption that any output above break-even point will produce profit is invalidated.

For this reason, break-even charts should be used only within the **known range of data**, and cost and revenue relationships should not be assumed to be valid outside this range. This range of data for which the known costs and revenue behaviour patterns are valid is known as the relevant range.

Contribution Break-Even Chart

A contribution break-even chart is an important improvement on the traditional break-even chart, since it is possible to read contribution direct from the chart. Instead of commencing by measuring the fixed costs from the base line, the variable costs are taken. The fixed costs are then shown above the variable costs, drawn parallel to the variable cost line.

Specimen Break-Even Chart Calculations and Construction

Variable costs	£2 per unit
Fixed costs	£80,000
Maximum sales	£200,000
Selling price per unit	£20

Prepare a contribution break-even chart (see Figure 8.5).

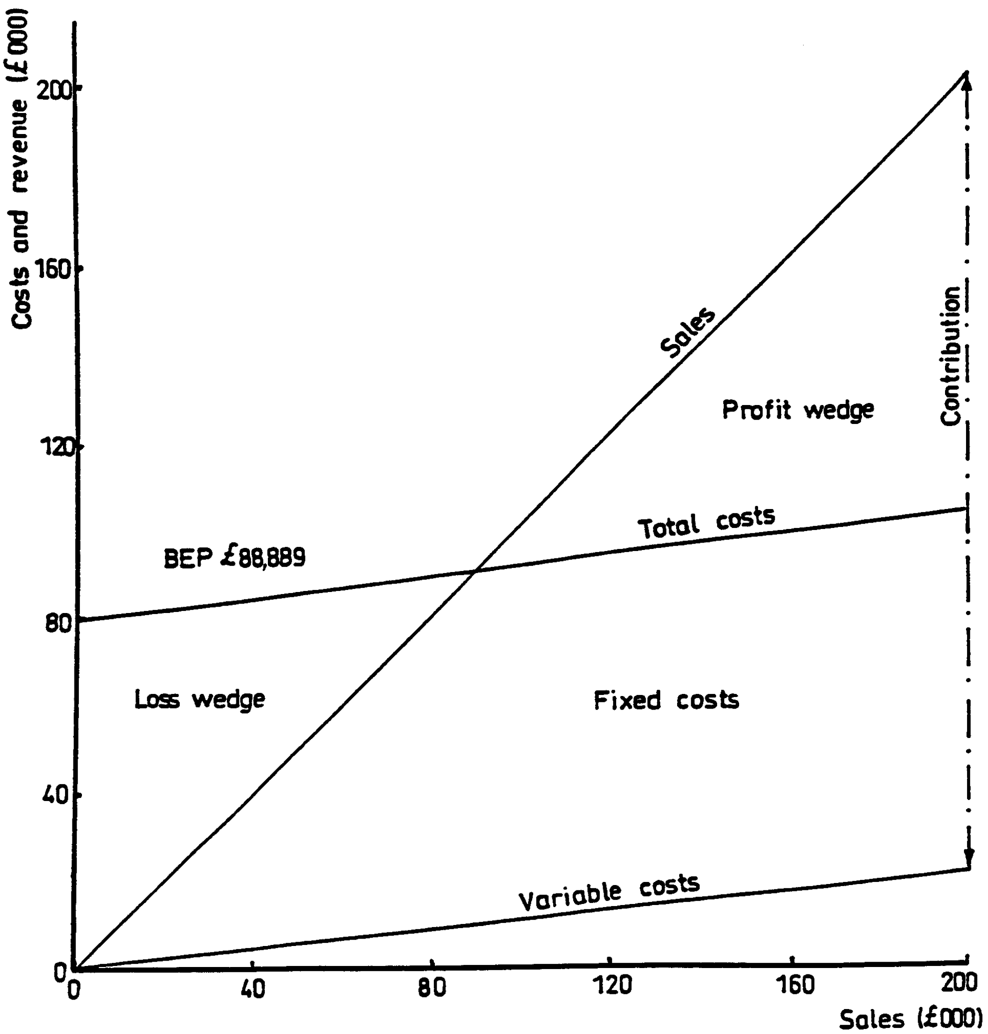

Figure 8.5: Contribution Break-Even Chart

C. THE PROFIT/VOLUME GRAPH (OR PROFIT GRAPH)

Profit and Activity Level

With the traditional break-even chart, it is not easy to read from the chart the profit at **any one level of activity**. The profit/volume graph (or profit graph) overcomes this problem, and it may be more easily understood by managers who are not trained in accountancy or statistics.

In this graph, the level of activity is plotted along the horizontal axis, against profit/loss on the vertical axis. You need, therefore, to **work out the profit** before starting to plot the graph:

Sales revenue – Variable cost = Fixed cost + Profit, or

Profit = Sales revenue – Variable cost – Fixed cost, or

$$\text{Profit} = \begin{pmatrix}\text{Selling price}\\ \text{per unit}\end{pmatrix} \times \begin{pmatrix}\text{Number of}\\ \text{units sold}\end{pmatrix} - \begin{pmatrix}\text{Variable cost}\\ \text{per unit}\end{pmatrix} \times \begin{pmatrix}\text{Number of}\\ \text{units sold}\end{pmatrix} - \text{Fixed cost, or}$$

Profit = Contribution per unit × Number of units – Fixed cost

(The form of the equation which is most convenient will depend on the presentation of the information in the particular question.)

Drawing the Graph

The general form of the graph is illustrated in Figure 8.6.

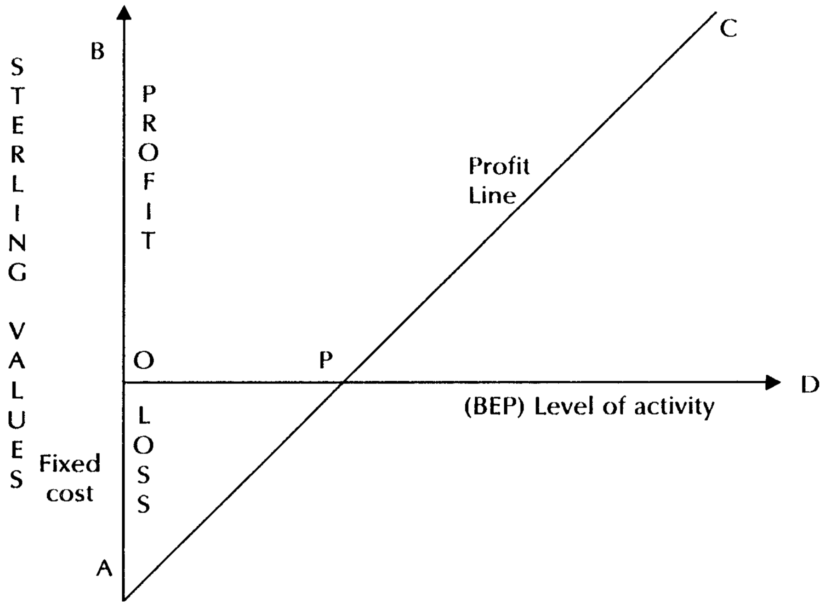

Figure 8.6: Profit Graph (or Profit/Volume Graph)

The distance A0 on the graph represents the amount of **fixed cost**, since, when no sales are made, there will be a loss equal to the fixed cost.

Specimen Profit/Volume Calculations and Graph

Try this practical problem for yourself, using some graph paper if possible. MC Ltd manufactures one product only, and, for the last accounting period, the firm has produced the simplified profit and loss statement shown below:

Profit and Loss Statement

	£	£
Sales		300,000
Costs:		
Direct materials	60,000	
Direct wages	40,000	
Direct cost	100,000	
Variable production overhead	10,000	
Fixed production overhead	40,000	
Fixed administration overhead	60,000	
Variable selling overhead	40,000	
Fixed selling overhead	20,000	270,000
Net profit		£30,000

You need to construct a profit/volume graph, from which you can state the break-even point and the margin of safety.

You are again advised to adopt the suggested layout of

	£
Sales	
less Variable cost	
Contribution	
less Fixed costs	
Profit	

Answer

	£
Sales	300,000
less Variable cost	150,000
Contribution	150,000
less Fixed costs	120,000
Profit	30,000

When sales are nil the company will still have to pay its fixed costs. It will therefore incur a loss of £120,000. This provides the first point (A) on the graph.

When sales are £300,000 there is a profit of £30,000 which provides the second point (B) on the graph.

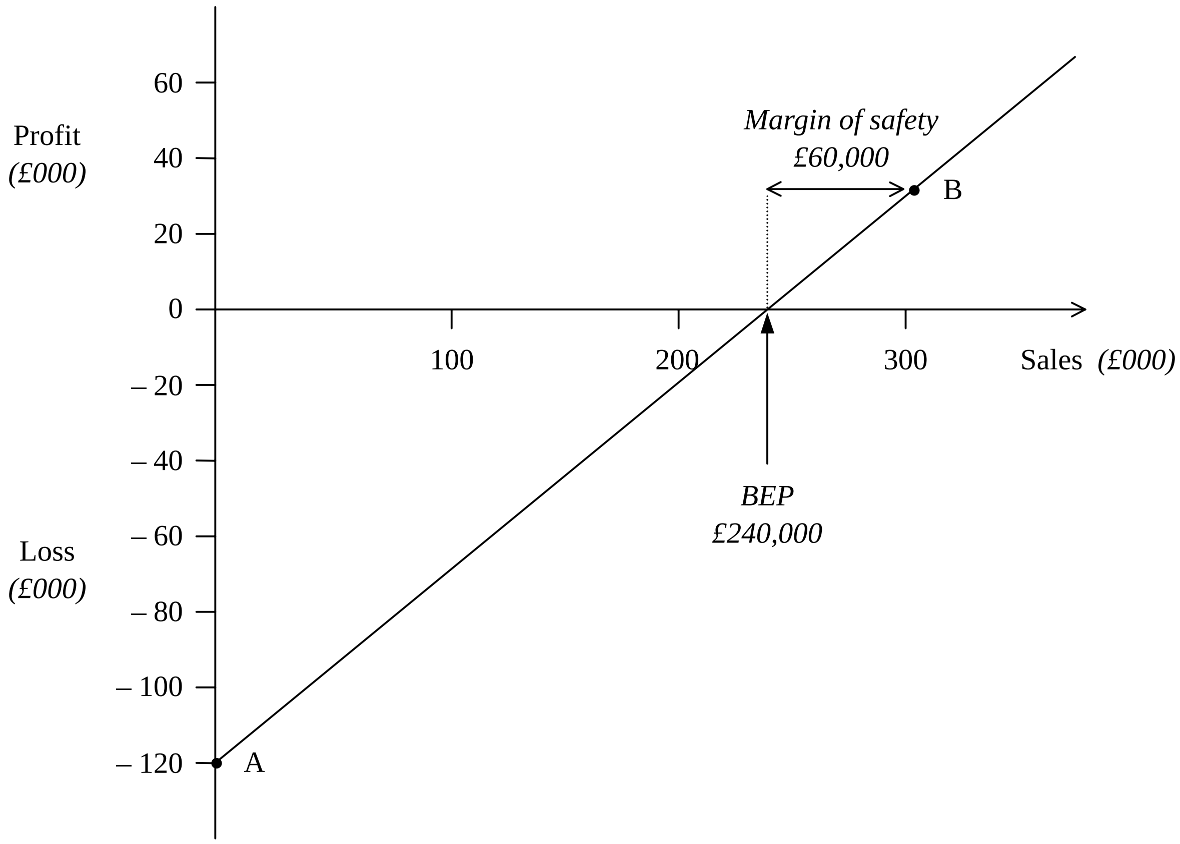

Figure 8.7: Profit/Volume Graph for MC Ltd

Further P/V Calculations

Attempt this second practical problem for yourself, **before** studying the solution.

The following information has been extracted from the books of XYZ Ltd.

XYZ Ltd	£	£
Variable costs:		
Direct material	100,000	
Direct labour	50,000	
50% of production overhead	50,000	200,000
Fixed costs:		
Administration 100%	100,000	
50% of production overhead	50,000	150,000*
Profit		50,000*
Sales revenue (80,000 units)		400,000

∗ *Note: Fixed costs (£150,000) + Profit (£50,000) = Contribution (£200,000)*

Prepare the following:

(a) A break-even chart showing the break-even (B/E) point (in £ and units), and the margin of safety.

(b) Arithmetical calculations supporting the information required in (a) above.

Answer

(a) Figure 8.8 shows the required break-even graph.

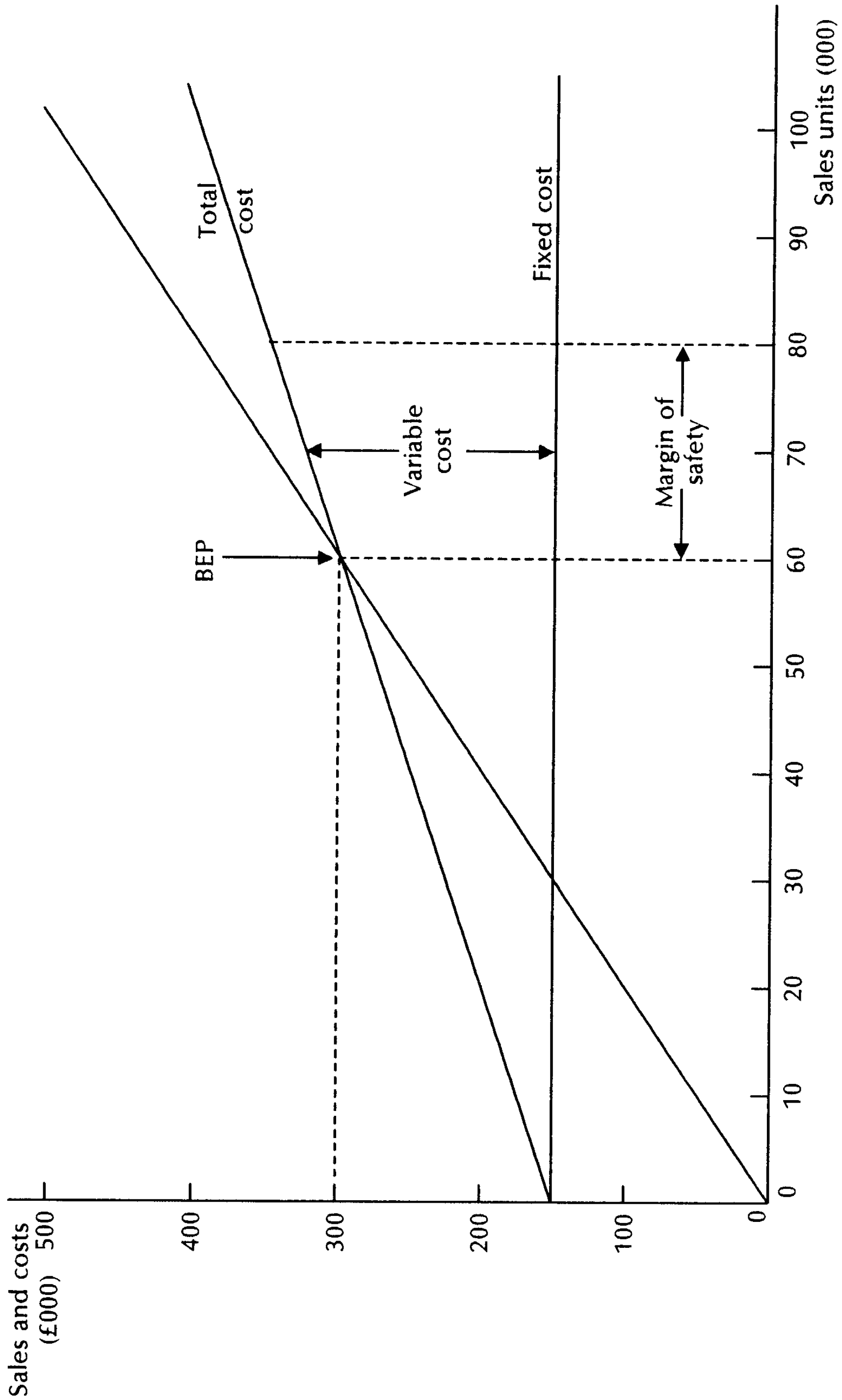

Figure 8.8: XYZ Ltd. Break-Even Graph

(b) Calculation of break-even point and margin of safety using formulae.

Break-even:

$$\text{B/E (£)} = \frac{F}{\left(\frac{S-V}{S}\right)} \quad \textit{where } \text{F = Fixed costs; S = Sales; V = Variable costs.}$$

$$= \frac{£150{,}000}{\left(\frac{400{,}000-200{,}000}{400{,}000}\right)} = £150{,}000 \times 2 = £300{,}000$$

$$\text{B/E (units)} = \frac{F}{\text{C per unit}} = \frac{£150{,}000}{\frac{200{,}000}{80{,}000}} = 60{,}000 \text{ units}$$

Margin of safety:

$$\text{M/S} = P \times \frac{S}{C} = £50{,}000 \times \frac{£400{,}000}{200{,}000} = £100{,}000$$

$$£400{,}000 - £300{,}000 = £100{,}000$$

$$\text{No. of units} = \frac{£100{,}000}{400{,}000} \times 80{,}000 = 20{,}000 \text{ units}$$

$$(80{,}000 - 60{,}000 = 20{,}000).$$

D. SENSITIVITY ANALYSIS

Sensitivity analysis involves adjusting one parameter at a time and measuring the effect that this has on the outcome. Thus, in terms of break-even analysis, this could involve adjusting the sales price or volume, variable or fixed costs and seeing which has the greater effect on profit. The objective is to find those parameters which are the most sensitive, i.e. with the greatest relative influence, so that management can be made aware of them.

Example

To illustrate the concept of sensitivity analysis, consider a firm which produces and sells one item which has a selling price of £6, variable cost of £4 and fixed costs of £700,000 per annum. Expected sales volume is 400,000 units per annum. Examine the sensitivity of each of these items.

If we assume a 5% movement on each item individually, we can compare how sensitive each parameter is. The current profitability is:

	£
Sales (400,000 × £6)	2,400,000
less Variable cost (400,000 × £4)	1,600,000
Contribution	800,000
less Fixed costs	700,000
Profit	100,000

A 5% decrease in sales value would have the following effect:

	£
Sales (400,000 × £5.70)	2,280,000
less Variable cost	1,600,000
Contribution	680,000
less Fixed costs	700,000
Profit	(20,000)

This shows that it has the effect of reducing profit by 120%.

Now consider a 5% increase in variable cost per unit:

	£
Sales	2,400,000
less Variable cost (400,000 × £4.20)	1,680,000
Contribution	720,000
less Fixed costs	700,000
Profit	20,000

This results in an 80% decrease in profit.

Next let us review a 5% reduction in sales volume:

	£
Sales (380,000 × £6)	2,280,000
less Variable cost (380,000 × £4)	1,520,000
Contribution	760,000
less Fixed costs	700,000
Profit	60,000

This is a 40% reduction in profit.

Finally, consider a 5% increase in fixed cost:

	£
Contribution (as per original)	800,000
less Fixed costs (including 5% increase)	735,000
Profit	65,000

This is a 35% reduction in profit.

What these figures show, therefore, is that sales value is the most sensitive item in that a proportionate percentage change causes a disproportionate decrease in profit. There is, however, a danger that too much could be read into the figures unless further investigation were to be carried out. The decrease in sales value, for instance, may result in increased sales volumes which would partially offset any drop in profits. The important thing to remember is that sensitivity is an indication to management of where potential problem areas may be, or, conversely, where improvements should be made which will yield greater results in terms of the effort put in.

Sensitivity Analysis and Break-Even Charts

The effects of sensitivity analysis can also be shown using a B/E chart. If we take the original example we considered and also show the effect of a decrease in sales revenue, we have a graphical picture of the change.

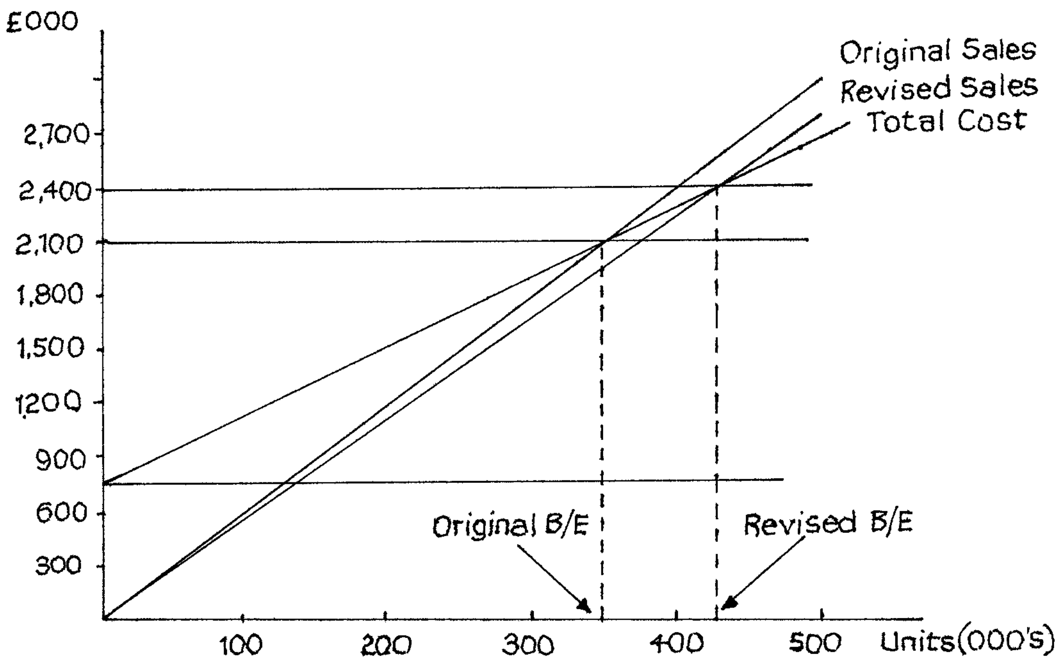

Figure 8.9

The original B/E point is $\dfrac{£700{,}000}{£6 - £4}$ = 350,000 units.

The revised B/E point is $\dfrac{£700{,}000}{£5.70 - £4}$ = 411,765 units.

In other words, an additional 61,765 units would need to be sold to achieve the break-even position, which represents an increase of 17.6%. Recalculate the break-even point using the other changes outlined earlier to confirm that sales value is the most sensitive item.

Note that changes in relative costs and sales value will alter the slope of the line. P/V charts can also be sensitised but in this instance the slope does not alter. Instead, the intersection of the lines will change and hence the B/E point will change also.

Study Unit 9

Planning and Decision Making

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INTRODUCTION

Earlier in the course we examined the types and sources of information which management require in order to make decisions. Following on from that, we considered how information can be categorised in terms of cost analysis to provide management with what they require in the appropriate format to aid the decision-making process.

Before looking at specific scenarios, this study unit will develop the concept of decision making by examining when and why it is required and the steps involved in it.

Management decision-making is complex and requires knowledge of:

- management accounting principles and techniques
- organisational objectives and functions
- management techniques
- the relationship between an organisation, its members and its environment.

A. THE PRINCIPLES OF DECISION MAKING

We can state this quite simply as making the right decision at the right time in the right place. While this objective is simple to state, it is far more difficult to achieve.

- The **right decision** can only be made by analysing the circumstances which relate to the decision and the purpose of making it.
- The **right time** acknowledges the fact that decisions are followed by action. Decisions must be made at the appropriate time so that effective action can be taken.
- The **right place** ensures that decisions are made in the most effective location. This is particularly important in large organisations with extended communication channels. Frequently the right place for making decisions is where the action they relate to will be carried out.

The whole point of management decision-making is that it should result in **effective action**.

Effective Decision-Making

The effectiveness of any manager in today's business environment will depend upon his ability to make effective decisions. A business can only achieve its objectives if its managers make effective decisions that are compatible with the organisation's objectives.

Example

If the objective of a retail store is profit maximisation, decisions must be made on:

- What range of products to stock
- What quantity of each product to stock
- What price to charge for each product
- Where the retail outlet should be located
- What staffing levels are required
- When the store should open for business

- Whether premises should be rented, leased or purchased

This list of decisions is only the beginning. You must appreciate that managing a business or any other type of organisation in today's environment is complex and can only be achieved by managers continuously making a series of complex decisions, all of which are interrelated. Decision making is further complicated by the fact that the environment is changing at a very fast rate; this means that decisions made at one time may quickly become obsolete. Decisions should therefore be related to the environment, and expected changes which are likely to occur in the environment should be taken into account when decisions are made.

The following factors should be taken into account when making management decisions.

(a) Decisions must be compatible with the organisation's objectives.

(b) Decisions must be based upon the facts surrounding the situation. To make effective decisions a decision maker must obtain relevant information.

(c) Decisions must be made before action can follow.

(d) Sufficient time must be allowed so that a decision maker can assimilate the relevant information.

(e) Decisions must be expressed in clearly defined plans, standards and instructions so that the appropriate action can be executed.

(f) Decisions made by a decision maker should be compatible with his responsibilities and authority.

(g) Decision makers should have the expertise and ability to make the decisions for which they are responsible.

(h) Information presented to decision makers should be in a form they can understand.

(i) There must be fast and effective communication channels between people involved in the decision-making process.

(j) Each decision must be related to its effect on the whole organisation. This is important so that sub-optimisation is avoided.

(k) Each decision must be carefully considered with regard to its effect on the environment, e.g. the reaction of competitors must be considered when making marketing decisions.

(l) The faster decisions can be made, the sooner action can be taken.

Levels of Decision Making

Decision making can be related to the hierarchy of an organisation. You can see this illustrated in Figure 9.1.

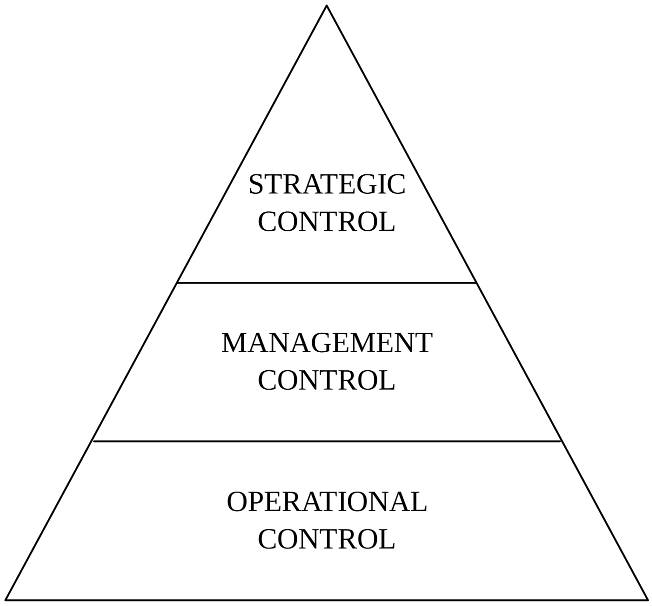

Figure 9.1

(a) Strategic Decisions

These are decisions made by top management. They normally relate to the long-term future and will provide the basis upon which an organisation's long-term plans will be formulated. Strategic decisions usually affect the whole organisation and involve the expenditure of large amounts of capital.

It is essential that at this level wrong decisions are not made. Bad strategic decisions are difficult to change and may result in substantial losses.

An example of strategic decision-making is when the directors of a company decide that a company should go into full-scale production of a new product.

If the new product is successful the company's profitability should increase, but if the new product is a failure, substantial losses will result and the money invested in producing and marketing the new product will be lost.

(b) Tactical Decisions

This type of decision is made by middle management and relates to the specialist divisions within the organisation. The divisions within an organisation will depend upon:

- The nature of its activities
- Its size
- The way it is structured

You must note these three factors when thinking about tactical decision-making.

If an organisation is structured by **function**, tactical decisions will relate to each specialist function, e.g. marketing, production, personnel and finance.

If an organisation is structured by **region**, tactical decisions will relate to each area, e.g. in the National Health Service tactical decisions will relate to each Regional Health Authority.

If an organisation is structured by **product type**, tactical decisions will relate to each product classification.

Tactical decisions have a shorter time horizon than strategic decisions and have a less far-reaching effect on the organisation.

(c) Operating Decisions

These are decisions made by operating (low-level) managers. They are made on a day-to-day basis, usually on an ad hoc basis. These decisions are dictated by events at the operating level of the organisation and are most effective when made:

- Quickly so that fast action can be taken.
- By a trained decision maker.
- Close to where the action is to be executed so that action can be instantly controlled by the decision maker.

Frequently, operating decision-making is not effective because of a failure to apply one or more of these three criteria.

Effective operating decision-making is an essential requirement for running a service undertaking successfully. In these undertakings situations quickly deteriorate when operating problems arise and rapid decisions are needed by properly trained personnel to solve them.

Operating decisions involve less capital investment than strategic and tactical decisions, but their long-term effect on an organisation is often underestimated by senior management. Operating decisions affect staff morale and/or customer goodwill.

Examples of important operating decisions are:

- Deciding what action to take to deal with customer complaints.
- Dealing with individual staff problems.
- Deciding how to allocate scarce resources on a day-to-day basis.

Operating decisions are often needed for unpredicted events and are made as a result of feedback.

Stages of the Decision-Making Process

Organisations normally initiate formal decision-making procedures which are followed by management. These procedures will vary between organisations but are likely to follow a number of stages arranged in a structured sequence.

It is important that any person making an organisational decision is able to adopt a logical, structured approach. Managers cannot be trained to make specific decisions; they can only be trained to take a specific approach to decision making.

We can list the approaches to decision making as follows:

Stage 1: Identifying the Objectives of the Organisation

As we said earlier, decisions made by management must be compatible with the organisation's objectives.

Stage 2: Defining the Purpose of the Decision

Every organisational decision made should have a purpose. In any decision-making situation it is important to define the purpose of making the decision; this is normally the logical reason for taking or not taking a particular course of action. A lot of the work involved in decision making is based upon logic.

Stage 3: Identifying the Potential Courses of Action

At this stage it is important to consider the potential courses of action that are dependent upon the decision. In decision-making situations it is important to establish exactly how many possible courses of action there are. Situations that arise include:

- Where only one course of action is considered, and the decision is whether to follow the particular course of action or not, such as in branch or departmental closure decisions.
- Where a number of alternative courses of action are possible but only one can be taken, such as in investment decision situations where, perhaps, four different projects are being considered, but there are only sufficient funds available for one to be selected.
- Where many alternative courses of action are possible and all of them can be achieved simultaneously, such as when deciding upon the range of products to be produced and sold when resources exist to produce the whole range.
- When the possible courses of action are mutually exclusive. In this situation the following of one course of action automatically means that the others are not possible, e.g. setting a production level for a product.

Stage 4: Obtaining the Relevant Information

Once the potential courses of action have been identified, the information that is relevant to them should be collected, processed and produced in a report for analysis. Management accounting techniques are widely used at this stage particularly:

- Relevant costing
- Differential costing
- Contribution analysis
- Opportunity costing
- Capital investment appraisal

Stage 5: Evaluation of the Options

At this stage each possible option must be carefully evaluated and the relevant information analysed.

This evaluation must take into account the organisation's objectives and the purpose of making the decision. Care should be taken to consider all the relevant criteria including quantitative and qualitative factors.

Stage 6: Making the Appropriate Decision

This is the point at which the course of action to be taken is decided upon. This should always be after the options have been evaluated.

Stage 7: Action

Once made, the decision should be communicated to those people responsible for carrying it out. Effective decisions should always result in effective action being taken.

Stage 8: Review

The final stage of the decision-making process is to carry out a review of events after the decision has been implemented. This is done by implementing control procedures. The review will enable management to see if the original decision was effective.

B. DECISION-MAKING CRITERIA

An important element of decision making is the relationship between a decision and the organisation and its environment. Decisions must be coordinated so that the whole organisation benefits from the action that follows. A decision maker has to make a number of criteria into account when making a decision. These decision-making criteria fall into two basic groups: quantitative factors and qualitative factors.

Quantitative Factors

These criteria cover all those factors which can be expressed in measured units. The following is a detailed list of the quantitative factors which a management decision-maker should take into consideration.

(a) Profitability

Commercial undertakings operate with profit maximisation as a primary objective; business decisions should be made with this objective in mind. In business, the effect of a decision on profitability is an important consideration.

(b) Effect on Cash Flow

Many decisions, especially those involving the investment of funds, affect the organisation's cash flow. You must appreciate that cash is a limited resource which places a severe restriction on management action.

(c) Sales Volume

Another factor that must be considered is the effect of a decision on the sales volume of a product or service. This is very important in pricing decisions, decisions affecting the quality of a product and decisions that affect a product or service availability.

(d) Market Share

In a highly competitive environment businesses consider market share to be an important factor. In such a situation the effect of a decision on a firm's market share for a particular product or service should be taken into account.

(e) The Time Value of Money

Another important factor to consider in long-term decision making is the fact that money in the future is worth less than it is at present. Techniques which take this into account are widely used in long-term decision making, e.g. Net Present Value (NPV) and the Internal Rate of Return (IRR).

(f) Efficiency

Organisations also operate with maximisation of efficiency as an important objective. Efficiency is measured by using the ratio:

$$\frac{\text{Output}}{\text{Input}}$$

If this ratio is less than 100% it means some resources used have been wasted. The effect of decisions on the organisation's efficiency should be taken into account. Many decisions should be made specifically to improve efficiency, e.g.:

- To reduce idle time

- To improve the productivity of the workforce
- To eliminate the loss of materials

(g) Time Taken to Make a Decision

One quantitative factor often overlooked in decision making is how long it takes to make a decision. To be effective it should always take less time to make a decision than it takes to effect action from the present time. For example, if action must be taken within the next three months, the decision whether to take action or not must take less than three months.

Qualitative Factors

These decision-making criteria cover all those factors which must be considered that cannot be expressed in measured units of any kind. These factors are just as important as the quantitative ones, and include:

(a) Competitors

In a business situation some decisions, such as those affecting prices, conditions of trade, availability of products and services, marketing, takeovers and mergers and the quality of goods and services, will result in competitors reacting to them in a certain way. The likely reaction of competitors must be carefully evaluated before such decisions are made.

(b) Customers

Many decisions made within organisations affect customers. The effect of business decisions on customers must always be considered if a firm is to survive and be profitable. Such decisions will be those which affect marketing and prices, product/service availability, product/service quality and the organisation's image.

(c) Government

Some decisions, particularly strategic ones, must take into account the attitude of both central and local government. Such decisions will be those affecting employment, location of premises, takeovers and mergers, importing and exporting. The government can support, oppose or prevent decisions being made, e.g. the Monopolies Commission can prevent one company merging with, or taking over, another business.

(d) Legal Factors

The effect of laws on decisions must also be considered, e.g. the effect of the relevant employment legislation must be taken into account when making decisions relating to personnel matters. The relevant tax laws are also important legal factors which must be considered. Taxation can also be viewed as a quantitative factor.

(e) Risk

Decisions are made about the future based upon information available at the present time. In such a situation there is always a risk that actual events, when they occur, will not be as expected. This means that there is always a risk that decisions may not work out as expected. The longer the time horizon affected by the decision, the greater the risk.

(f) Staff Morale

The effect of decisions on the morale of the workforce must always be considered. Decisions to close down part of an operation, discontinue a product line, make staff redundant or purchase products or components from outside suppliers instead of manufacturing them in-house, tend to lower the morale of the workforce.

(g) Suppliers

Suppliers must also be taken into account. An organisation which becomes dependent upon just one or two suppliers becomes vulnerable if a supplier decides to change its product range or specification. The supplier can then dictate terms and increase its prices knowing that the customer is dependent upon it. Another factor to consider in this situation is what might happen if a competitor was to take over a major supplier.

(h) Flexibility

The environment is constantly changing. It is important that flexibility is considered when making decisions. Decisions should always be kept under review and new decisions made when necessary. Management should always remember that decisions can be changed right up to the time action is taken. An adaptive approach to decision making should always be taken.

(i) Environment

One factor that has become increasingly important in recent years is for a decision maker to evaluate the effect of a decision on the environment. Organisations are **open systems** which interact with their environment. Decisions that affect pollution, noise, social services and the physical environment such as buildings, must take the environment into consideration.

(j) Availability of Information

A decision maker must consider whether sufficient information is available to make a decision. Frequently decisions have to be made with incomplete information; this is where a manager's ability to judge a situation is important. A decision maker must also be able to assess the reliability and accuracy of information used. Many bad decisions are made because of inaccurate information.

Thinking for Decisions

An effective decision-maker must carefully relate the decision being made and its effects on:

(a) The part of the organisation directly involved

(b) Other parts of the organisation not directly involved

(c) The whole organisation

(d) The environment

(a) and (b) mean thinking **laterally**, (c) means thinking **vertically**, and (d) means thinking **outwardly**.

C. COSTING AND DECISION MAKING

Relevant Costing

This topic was discussed earlier in the course, but it may be useful at this stage to refresh your memory.

Relevant costing is an important part of the decision-making process. When managers are deciding between various courses of action, the only information which is useful to them is detail about what could be changed as a result of their decision making – i.e. they need to know the **relevant costs** (or incremental or differential cost – see the next section).

Remember the CIMA definition of relevant costs:

"Costs appropriate to aiding the making of specific management decisions."

Differential Cost Analysis

Most business decisions involve an estimation of **future costs**. Costs which change as a result of a decision are **differential** or **incremental** costs involving both fixed and variable elements. Incremental or differential cost analysis is particularly used where changes in volume are being considered or further processing decisions are to be made. The following example illustrates the application of this type of analysis to a decision on the possible closure of a factory.

Example

X Ltd has two factories, East and West, both of which produce product EW 90. West occupies a company-owned freehold factory; the East factory is leased.

The lease for the East factory is now due for renewal and, if the proposed terms are accepted, the rental will increase by £15,000 per annum. The company's head office costs are allocated to factories on the basis of sales value. The following sales and costs apply to the budgeted results for the year before the rental increase.

	West	**East**	**Head Office**	**Total**
Sales *(units)*	30,000	20,000	–	50,000
	£	£	£	£
Sales	600,000	400,000	–	1,000,000
Variable costs				
Materials	120,000	80,000	–	200,000
Direct wages	180,000	110,000	–	290,000
Variable manufacturing overheads	60,000	30,000	–	90,000
	360,000	220,000	–	580,000
Fixed costs				
Rent	–	40,000	5,000	45,000
Depreciation	60,000	20,000	10,000	90,000
Other fixed overheads	70,000	60,000	65,000	195,000
Total costs	490,000	340,000	80,000	910,000

If the lease of the East factory is not renewed, the production facilities at the West factory can be expanded to cover the loss of production from East. To produce the additional output, new plant and equipment will be required which will cost £200,000. The additional plant would be depreciated over a five-year period on the straight-line basis with no residual value anticipated. The purchase would be financed by a loan, bearing interest at 10% per annum.

Additional selling and distribution costs of £0.20 per unit sold will be incurred on sales made to customers at present in the territory covered by East.

The expansion of the West factory would cause its fixed costs to rise by 40%. Head office costs would not be affected. Variable manufacturing costs would be based on the present unit costs incurred by West.

Receipts from the sale of plant and equipment would cover closure costs of the East factory.

Required:

(a) Give calculations to show which alternative would be more profitable.

(b) Show the return on the additional investment if all manufacturing is carried out at the West factory.

Answer

(a) The present profit is £90,000. If the lease is renewed, this will fall to:

£90,000 – £15,000 = £75,000.

The position if East is closed and West expanded will be as follows:

	West (as now) £	**Incremental revenue and costs** £	**New total** £
Sales	600,000	400,000	1,000,000
Variable costs			
Direct materials	120,000	80,000	200,000
Direct wages	180,000	120,000	300,000
Variable overheads	60,000	40,000	100,000
Additional selling and distribution expenses	–	4,000	4,000
	360,000	244,000	604,000
Contribution	240,000	156,000	396,000
Fixed overheads			
Depreciation	60,000	40,000	100,000
Interest on loan	–	20,000	20,000
Fixed overheads	70,000	28,000	98,000
	130,000	88,000	218,000
Surplus	110,000	68,000	178,000
HO costs			80,000
Net profit			98,000

The net profit of £98,000 compares with a net profit of £75,000 if the lease on the East factory is renewed.

Note that variable costs have been based on West's present unit costs.

(b) The return on the additional capital employed will be:

$$\frac{68,000}{20,000} = 34\%$$

This represents the additional surplus earned by West in relation to the additional capital invested.

Sell or Process Further

Decisions relating to the further processing of products are often associated with **joint products**, where separation point is reached and the products can either be sold or subjected to further processing with an increase in their saleable value. These decisions involve the principle of incremental costing and the basic requirement is to compare the **incremental sales** value with the **incremental costs**. For the purposes of such decisions, the joint costs of production are irrelevant.

Example 1

Xcel Ltd produces three joint products, X, Y and Z, from a common process. Annual costs for the joint process are as follows:

	£
Direct materials	155,000
Direct wages	60,000
Variable overheads (150% of direct wages)	90,000
Fixed overheads	90,000

The budgeted outputs and selling prices at separation point are:

	Production *Tons*	**Price** *£ per ton*
X	2,000	100
Y	1,000	150
Z	500	200

Production capacity is available to process further any one or all of the products. Additional labour and materials would be required in each case, and the following estimates have been prepared of costs and sales values if further processing is carried out:

	X	Y	Z
Quantities (tons)	2,000	1,000	500
Additional materials	£12,000	£15,000	£10,500
Additional direct wages	£12,000	£10,000	£10,000
Total sales value (after further processing)	£240,000	£210,000	£150,000

The management wishes to know which products should be sold or processed further, and the difference in the anticipated trading results between processing and selling at separation point.

Answer

It should be noted that, in addition to the added materials and labour, allowance must be made for **variable overheads**, and these should be included in the calculations at the rate of 150 per cent of direct wages.

The first step is to calculate the incremental sales and costs figures. Sales values before further processing are:

Product X	2,000 × £100	= £200,000
Product Y	1,000 × £150	= £150,000
Product Z	500 × £200	= £100,000

The incremental sales values are, therefore, as follows.

	X £	Y £	Z £
Before further processing	200,000	150,000	100,000
After processing	240,000	210,000	150,000
Incremental value	40,000	60,000	50,000

Incremental costs are:

	X £	Y £	Z £
Direct materials	12,000	15,000	10,500
Direct wages	12,000	10,000	10,000
Variable overheads	18,000	15,000	15,000
	42,000	40,000	35,500

The incremental profits and losses are:

Product	£
X (loss)	(2,000)
Y profit	20,000
Z profit	14,500
Net gain	32,500

The recommendation is that only products Y and Z should be further processed. This will result in additional profit of £34,500.

The results with and without additional processing are as follows:

Without additional processing

	£	£
Sales		450,000
Direct materials	155,000	
Direct wages	60,000	
Variable overheads	90,000	
Fixed overheads	90,000	395,000
Net profit		£55,000

With additional processing

	£	£
Sales		600,000
Direct materials	192,500	
Direct wages	92,000	
Variable overheads	138,000	
Fixed overheads	90,000	512,500
Net profit		£87,500

Incremental profit = £87,500 – £55,000 = £32,500

Example 2

A company manufactures four products from an input of raw material to Process 1. Following this process, Product A is processed in Process 2, Product B in Process 3, Product C in Process 4 and Product D in Process 5.

The normal loss in Process 1 is 10% of input and there are no expected losses in the other processes. Scrap value in Process 1 is £0.50 per litre. The costs incurred in Process 1 are apportioned to each product according to the volume of output of each product. Production overhead is absorbed as a percentage of direct wages.

Data in respect of one month's production

	Process					**Total**
	1	**2**	**3**	**4**	**5**	
	£000	*£000*	*£000*	*£000*	*£000*	*£000*
Direct materials at £1.25 per ltr	100					100
Direct wages	48	12	8	4	16	88
Production overhead						66

	Product			
	A *litres*	**B** *litres*	**C** *litres*	**D** *litres*
Output	22,000	20,000	10,000	18,000
	£	£	£	£
Selling price	4.00	3.00	2.00	5.00
Estimated sales value at end of Process 1	2.50	2.80	1.20	3.00

You are required to suggest and evaluate an alternative production strategy which would optimise profit for the month. It should not be assumed that the output of Process 1 can be changed.

Answer

The object of the exercise is to determine whether the best option available is to process the output further or sell it at a particular point. Much will depend on the assumptions made in respect of the various costs involved. For instance, can the direct wages and/or production overhead be avoided if further processing does not take place after Process 1? We shall assume that the production overhead is fixed and therefore cannot be avoided in the short term, and that the direct wages are variable with output and therefore can be avoided.

The first exercise to carry out is to ascertain the additional sales value arising from further processing and then to compare this with the additional costs incurred.

	A	**B**	**C**	**D**
	£	£	£	£
Selling price at end of Process 1	2.50	2.80	1.20	3.00
Selling price after further processing	4.00	3.00	2.00	5.00
Increase in sales value per unit	1.50	0.20	0.80	2.00
	litres	*litres*	*litres*	*litres*
Output (litres)	22,000	20,000	10,000	18,000
	£000	*£000*	*£000*	*£000*
Increase in revenue from further processing	33	4	8	36
Avoidable costs after split-off point	12	8	4	16
Benefit/(cost) of further processing	21	(4)	4	20

It would appear that Products A, C and D should be further processed in order to increase the overall return, but that Product B should be sold at the end of Process 1, thus avoiding a loss of £4,000 per annum.

Consideration should also be given to ascertaining whether some or all of the production overhead would be saved. These overheads constitute 75% of direct wages (£66,000 to £88,000) so that the saving by not further processing Product B rises by £6,000 (75% of £8,000), whilst the decision on Product C becomes marginal as £3,000 (75% of £4,000) could be saved by leaving an incremental value of just £1,000.

Study Unit 10

Pricing Policies

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INTRODUCTION

This study unit will be considering the importance to the firm of setting the correct price for its products and the different methods by which price can be calculated.

Through pricing, a company provides for the recovery of the costs of its operations – marketing, production and administration. In addition, the company must recover sufficient surplus over and above these costs to meet profit objectives. It is important, therefore, to consider price as a fundamental part of a company's overall effort and to ensure that it plays an important role in the development and control of a company's strategy.

A. FIXING THE PRICE

External selling prices will be influenced by many different factors, but as a basis for further calculations, many firms begin by calculating the costs of production, including fixed and variable costs, and adding a desired profit margin, to arrive at a **provisional selling price**. Before fixing a final selling price, other factors may require consideration, including:

- The firm's **sales and profit strategies** and target figures.
- The extent of **competition**, and whether prices are determined mainly by dominant firms in the industry.
- The current level of **demand** for the company's products.
- Whether demand is **seasonal, constant**, or products are made to **individual customer requirements**.
- Whether demand is **elastic** or **inelastic** (see your notes on economics if you wish to revise the meaning of these terms).
- The **present stage of the life-cycle** of the product, and whether an existing line is being phased out and stocks run down (see later).
- Any element of **dislocation** which may be caused by the urgency of a particular order or delivery requirements.

Prices may also be influenced by legal and general economic factors, such as government policies and regulations, and exchange-rate fluctuations.

We shall now consider some of the above in greater detail.

B. PRICING DECISIONS

Determinants of Upper and Lower Limits to Price

We may think in terms of upper and lower limits to the price charged for a product or service.

The upper limit is determined by the maximum price which a potential purchaser will pay. The price of a product or service should not exceed the value of its benefit to the buyer. The lower limit is determined by the fact that in the long term the price should not fall below the cost of making and distributing the product.

The two factors which simultaneously determine the upper and lower limits to price, therefore, are **demand** and **cost**. Because of their importance in pricing decisions, we will examine each of these factors in greater detail.

Demand Analysis

(a) Information Required

Of all the factors affecting pricing decisions, information on demand is perhaps the most important.

We have stressed that demand forms the upper limit to pricing decisions. We cannot charge prices higher than those which the market will bear. Ideally, we should have information bearing on the following two interrelated questions:

- What will be the quantity demanded at any given price?
- What is the likely effect on sales volume of changes in price?

What we are discussing may be referred to as the **price sensitivity of demand** and, clearly, knowledge of this places us in a position to make informed decisions on price. However, useful as such information is in assessing and interpreting price sensitivity of demand, we must remember that:

(i) In markets where suppliers are able to **differentiate** their products from those of competitors, sales volume for the individual company is a function of:

- the total marketing effort of that company
- the marketing efforts of competitors.

It is therefore difficult to appraise the impact of a price policy upon sales without analysing the marketing activity of competitors.

(ii) Price sensitivity may be expected to differ between individual customers and/or groups of customers.

(b) Perceived Value and Pricing

Taken together, differentiated ‘products’ and differences in price sensitivity mean that the price sensitivity of demand confronting a company is influenced by the choice of market segment and the extent to which prices are congruent with the total marketing effort applied to these segments.

In analysing demand it is necessary to examine the **buyer’s perception of value** as the key to pricing decisions. Essentially, that involves appraising the benefits sought by customers, these benefits being reflected in their buying criteria.

This examination enables a company to select the most appropriate market targets and then to develop a marketing mix for those targets with respect to price, quality, service, etc.

(c) External Influences on Demand

Finally, we need to remember that overall demand and possible changes in demand for products can be influenced by factors which may be outside a company’s control. Examples of these factors are income levels, legislation and fuel prices.

Cost Considerations

(a) The Role of Cost Inputs

Even though costs generally do not **determine** prices, obviously cost is a primary factor in **evaluating** pricing decisions. Among the key roles which information on costs plays are:

- measuring the profit contribution of individual selling transactions
- determining the most profitable products, customers, or market segments
- evaluating the effect on profits of changes in volume
- indicating whether a product can be made and sold profitably at any price.

(b) Requirements of a Costing System

Accurate, relevant and timely data on costs is essential for a costing system. In addition, the costing system should be flexible. These key aspects of information on cost are expanded below.

(i) Accuracy

It is important that a company's cost analysis allows it to identify costs accurately for each product, activity, customer etc. In this way management is able to make **informed** decisions about volume mix and pricing to target market segments.

(ii) Relevance

It is important that cost analysis is performed and presented on a basis relevant to decision-making. In particular, the cost analysis should distinguish between fixed and variable costs, and specify the relationship between these and volume. Also required is information on costs relative to those of competitors.

(iii) Timeliness

In order to be useful for decision-making, information on costs should be made available at the appropriate time. This means that cost information should relate not only to historic costs but also to future expected costs.

Within this framework, information on costs should include:

- Costs of production and marketing – historical and future.
- Volume anticipated – extent of plant utilisation.
- Relation of capacity to cost.
- Contribution to overheads of products, activities, customers, etc.
- Break-even points.
- Interrelationships between costs of items in the product mix.

Pricing Policy and Procedures

Clearly, pricing decisions require that a number of factors be taken into consideration. A policy framework for pricing decisions is required which covers the following areas:

- determination of product price levels for existing products
- pricing new products
- implementation of price changes: strategic and tactical

- deviations from price levels, such as discount levels, rebate policy, etc.

In addition, a company must establish suitable organisational procedures for the implementation and administration of pricing, to cover, for example:

- responsibility for pricing decisions
- procedures for quoting prices
- procedures for price changes

Pricing Decisions and the Product Life-Cycle

The product life-cycle shows how firms adopt different pricing policies at different stages of a product's life. According to the product life-cycle theory a product goes through four stages:

- Introduction
- Growth
- Maturity
- Decline

(a) Introduction

At the introductory stage a firm is likely to charge high prices. This is because the product is new and will therefore have a novelty appeal. There will also be very few substitutes available and there is therefore no need to price competitively. The firm may have spent vast sums of money in developing and promoting the product, and so will be anxious to recover as much money as possible quickly and will consequently charge a high price.

(b) Growth

At the growth stage a firm will be keen to establish a high market share and may therefore slightly lower its price in order to generate more sales. This is usually a very profitable stage for the company because prices are still relatively high but the firm may have found techniques to lower costs, so contribution will be quite high. Sales volume increases considerably during this period and as a result a firm can make substantial profits. Naturally such firms will try to erect barriers to entry in order to discourage competition. Brand advertising together with patents and copyright are often an effective means of achieving this.

(c) Maturity

At the maturity stage a company may face severe competition. The high profits which it enjoyed in the growth stage may have attracted competition, and a number of new firms will have entered the market. This results in very competitive pricing. Generally, it is at this stage that firms achieve economies of scale. Factories will operate to full capacity and the manufacturing process (if one exists) is likely to become automated. All these factors will reduce costs and firms anxious to maintain or increase their market share will choose a price which is only slightly above average costs.

(d) Decline

Finally, at the decline stage a number of firms may be forced to leave the market. The reduction in the overall market may reduce the advantage of economies of scale. As a result prices may increase slightly, but profitability will drop.

C. PRACTICAL PRICING STRATEGIES

We will now examine some of the main pricing strategies which can be implemented by a business. You should be able to recognise and calculate prices for each method.

Full Cost Plus Pricing

This pricing strategy involves first calculating the **full** cost of producing a product or providing a service including a charge for fixed overheads. A percentage is then added to this cost as a profit margin.

Example

A company producing hand-crafted cut glass calculates its costs as follows for each glass produced.

	£
Direct material	2.50
Direct labour – 3 hours at £7.50 per hour	22.50
	25.00
Variable overhead – 3 hours at £2 per hour	6.00
Total variable cost	31.00
Fixed overheads – 3 hours at £3 per hour	9.00
Total cost per unit	40.00

The company's pricing strategy is to charge a price based upon a product's full cost plus 25%.

The selling price of one glass will be:

	£
Total cost	40.00
add 25% × £40.00	10.00
Selling price	50.00

Full cost plus pricing has three serious disadvantages:

- It ignores what price customers are prepared to pay for a product or service.
- It assumes that a firm operates at budgeted capacity. It does not take into account inefficiency such as idle time.
- It ignores the prices charged for competing products and services.

Full cost plus pricing does not take into account market forces. It is still in frequent use particularly by small firms and in certain industries such as the building trade.

Marginal Cost Plus Pricing

This pricing strategy involves calculating the **marginal** cost of producing a product or providing a service. This excludes a charge for fixed costs. A percentage is then added to the marginal cost for contribution.

Example

A company operating a hotel calculates the cost of providing accommodation as follows:

Variable cost per guest per night: £18.00

This is the marginal cost.

The company's pricing strategy is to charge a price based upon marginal cost plus 100%.

Therefore, the charge per guest per night will be:

	£
Marginal cost	18.00
add 100% margin for contribution (100% × £18)	18.00
Selling price	36.00

Marginal cost plus pricing has the following disadvantages:

- It ignores what price customers are prepared to pay for a product or service.
- If a business is operating at below its break-even point no profit will be made.
- It ignores the prices charged for competing products and services.

Marginal cost plus pricing is used as an alternative to full cost plus pricing and is frequently used by undertakings providing repair services, e.g. in motor vehicle servicing.

Competitive Pricing

This pricing strategy involves charging prices for products and services which are based upon the prices charged by competitors. It is an aggressive strategy which should ensure that an organisation maintains its competitive position. This strategy is compatible with objectives which are aimed at maximising sales volume or market share.

Example

An electrical retailer purchases a particular model of electric kettle at £84 for ten.

The prices charged by three competitors for the same product are as follows:

Retailer A	£10.85 each
Retailer B	£11.99 each
Retailer C	£11.85 each

In such a situation it is likely that potential customers will compare selling prices and therefore a competitive pricing strategy should be operated. This will ignore the cost of the product. In the situation above, any price could be charged between £10.85 and £11.99.

If the retailer wants to maximise sales volume, a price of £10.85 or lower should be charged for each electric kettle.

A price below £10.85 could be charged but the effect this will have on Retailer A, who may then reduce the product's price and start a 'price war', will have to be carefully considered.

Competitive pricing is widely used in retailing.

Market Forces Pricing

This pricing strategy takes account of market forces such as total market supply and demand and what value customers place on a product or service. Market forces are difficult to predict and are constantly changing. Firms operating this pricing strategy are constantly changing the prices of their product/service range with frequent price rises when demand exceeds supply and discounts when supply exceeds demand. Such firms spend considerable amounts of money on advertising to influence demand and on market research. This pricing method is used for marketing products that are unique, such as new and second-hand motor vehicles.

Example

A market research survey shows that many companies allow executives to purchase company cars at the following values.

£	
12,000	
15,000	Each price depends upon the grade of employee
18,000	
24,000	

A car manufacturer then produces and sells a range of new cars at these prices. When the value of company cars is increased by employers by, say 10%, the manufacturer simply increases the selling price of its product range by the same amount.

Loss Leaders

Some organisations are prepared to sell certain products at a loss. Their reasons for this may be to:

- attract customers who will then purchase other profitable products at the same time
- clear obsolete stock
- make room for more profitable stock when space is a limiting factor
- stimulate stagnant market conditions

Discriminating Pricing

Discriminating pricing is a strategy which results in different prices being charged for a product or service at different times. It is widely used in service industries where demand fluctuates over a short period of time. Its purposes are to:

- increase profitability when demand for the product or service is high
- reduce demand when it is higher than supply
- use of spare capacity when demand is low by increasing demand.

Discriminatory pricing is particularly used in the holiday trade, transport and by the electricity industry.

Example

A company selling holiday package tours finds that demand for holidays is high over the Christmas period and from late July to mid-September each year. From May to mid-July and during late September demand is moderate, while for the remainder of the year demand is low.

The pricing strategy operated by this company is as follows:

Period	Price
1 October – 15 December and 7 January – 30 April	Holidays are priced at a basic rate
1 May – 20 July and 15 September – 30 September	Holidays are priced at the basic rate plus a 30% premium.
21 July – 14 September and 16 December – 6 January	Holidays are priced at the basic rate plus a 75% premium.

Over a 12 month period this company charges three different prices for the same holiday.

Target Pricing

This involves targeting profit mark-up to a desired rate of return on total costs at an estimated standard volume.

The target pricing approach can be more flexible than the full-cost pricing approach in that the profit margin added to costs can be varied by individual product, product line, individual customer, market segments or a combination of these. In this way, the mark-up may be adjusted to reflect demand and competitive conditions between products and markets, to give an overall target rate of return to the company.

The main disadvantage of target pricing is that it has a major conceptual flaw. The method uses an estimate of sales volume to derive price, whereas in fact price influences sales volume. A target selling price pegged to a derived rate of return does not guarantee that it is acceptable in the market place.

Market Penetration and Market Skimming

These approaches to pricing are not so much methods of pricing as two contrasting approaches to determining the overall level of prices for a company's products compared with the competition. Market penetration and market skimming approaches to pricing are particularly relevant to new product pricing.

(a) Market Penetration

With a penetration pricing approach, the price is set low to stimulate growth of the market and to achieve a large market share. Market penetration is a valid approach to pricing a new product in the following circumstances:

- If the market is price-sensitive, i.e. if reductions in price bring about substantial increase in demand.
- If, by increasing its market share, and therefore its output, a company is able substantially to reduce average costs, i.e. it is able to make economies of scale.

- If a low price would discourage actual or potential competition.
- Where a company has sufficient financial assets to support a low price policy and possible initial losses.

(b) Market Skimming

In this approach to pricing, initial prices are set high and reduced in the later stages of the product life-cycle.

This approach assumes that some market segments are willing to pay more than others; for example, higher income groups and customers willing to pay for being among the first to purchase a new product.

The price is set high to obtain a premium from them and gradually it is reduced to attract the more price-sensitive segments of the market. This is a useful method of pricing if:

- there is a sufficient number of buyers whose demand is not price-sensitive
- unit production and distribution costs of producing a small volume do not cancel out the advantage of the price premium
- high prices do not stimulate potential new entrants to the market. This is the case if there is a patent, or high costs of entry into the market.

Minimum Pricing

This method is based on ensuring that certain costs to the business will be recovered. It is not necessarily the price that will be charged but it is an indication of the point below which sales prices must not drop. The costs to be considered are:

- The opportunity costs of the resources used in manufacturing and selling the product.
- The incremental costs of producing and selling the product.

Thus, relevant costing is an important part of calculating the minimum price; if there are scarce resources then the price would be based on the opportunity cost of production, whereas if there are no limits on production the price will be based on the incremental cost.

Limiting Factor Pricing

This is again based on relevant costing and could be used when a company is operating at full capacity and has a shortage of resources. Prices can be set based upon a mark-up per unit of limiting factor.

Example

Scoffit Bakeries Ltd produces 10,000 loaves a day from its two ovens which operate 24 hours a day, seven days a week (except for cleaning and maintenance). The limiting factor on the company is therefore the time available as the installation of a third oven would be uneconomic.

Per 100 loaves, the costs are £10 for direct material, £10 for direct labour and £30 direct production overhead. The latter includes the cost of power for the ovens. Fixed costs are £1,000 per day.

If the company wishes to make a contribution of £25 per 100 loaves, what should the selling price per loaf be and what will the daily profit be at this selling price?

Sales Price

	Per 100 Loaves
	£
Direct material	10
Direct labour	10
Product overhead	30
	50
Contribution required	25
Total sales	75

Sales price per loaf is therefore 75p.

Profit per Day

	£
Sales (10,000 × 75p)	7,500
Direct material	(1,000)
Direct labour	(1,000)
Production overhead	(3,000)
Contribution	2,500
Fixed costs	(1,000)
Daily profit	1,500

Return on Capital Pricing

This method of pricing attempts to achieve a required return on capital employed (ROCE). It is first necessary to establish the required rate of return on capital and to prepare an estimate of total annual costs.

Example

Assuming that A Ltd's capital employed is £1m, estimated total costs for the coming year are £1.5m, and the required rate of return on capital is 15 per cent. The mark-up on costs becomes:

$$\frac{\pounds 1\text{m}}{\pounds 1.5\text{m}} \times 15\% = 10\% \text{ on cost}$$

As with other forms of pricing, this method must be operated with some degree of flexibility to allow for selling prices to be varied according to circumstances from time to time.

D. FURTHER ASPECTS OF PRICING POLICY

Short- and Long-Term Policy

In the short term, prices which result in a loss may be justified, provided that the price level is consciously fixed in order to establish a new product, or gain a foothold in a new market. Short-term policies are in many ways much easier to plan and execute than long-term policies, since an error of judgement or calculation will not have such disastrous effects. In addition a short-term plan is open to amendment by its very nature; the policy-makers will always bear in mind that it may be discharged after a limited period of time.

It is, on the other hand, very difficult to formulate a long-term plan in view of the likelihood of steadily rising costs. This likelihood necessitates periodic checks on the progress of the plan, and these might obstruct a true long-term pricing policy. Much will depend, however, upon the nature of the business, and, to some extent, on the nature of the product. In a manufacturing business there is always the prospect that a new process will be invented that will reduce production costs, and also that astute bulk buying of raw materials will prevent the average raw material costs from rising too sharply. These advantages are frequently offset, however, by rising costs of labour and also by increases in production and other overheads.

In a merchanting business it is possible to frame a marketing or purchasing policy in the long term, but where the products are subject to wide variations in supply and demand during the course of a season, a long-term pricing policy would usually be impracticable. For example, in the commodity trades the merchant has to consider not only whether the crop is likely to be adequate to meet world demand, but also whether it is likely to be late, or the quality fully up to the required standard. In addition, there may be certain occurrences which nobody can foresee, such as natural disasters, severe labour unrest or political upheaval.

If a merchant charges prices that are too low he or she will incur regular losses, but if prices are too high most business will go to the competitors. The most satisfactory form of pricing policy is one where the seller aims to earn a certain fixed percentage above actual cost, but even here it may be necessary to make occasional adjustments where the prices asked are unattractive to buyers.

Quantity Incentives

Most sellers, whether manufacturers or merchants, would normally prefer to sell a large rather than a small quantity of the products in which they deal. It is sometimes necessary for a seller to give some form of incentive in order to attract large business. Some buyers prefer to spread their purchases over a number of suppliers in order not to be wholly dependent upon one source. If the seller, however, can give sufficient incentive to the buyer, it may be possible to book the whole quantity.

The form which the incentive takes will depend upon the negotiating powers of both parties, and also, to some extent, on the strength of the competition. The most obvious incentive is a reduction in price, although the seller must be particularly careful that the concession granted does not make the business uneconomic. Alternatively, the incentive may take the form of credit facilities at favourable rates of interest. Here it is not merely the cost of the credit given that must be considered, but also the feasibility of the credit plan. The credit concession may involve the company in a medium-term financial commitment which exceeds its facilities, and this may prove embarrassing to all concerned.

Discount Policy

There are two forms of discount – trade discount and cash discount.

(a) Trade Discount

A trade discount is one which is offered in the normal course of business, and may vary according to the quantity of goods sold. It is usual to give no discount for small quantities, and a discount on an ascending scale thereafter. An example of this would be no discount for 50 items; between 50 and 100, 1¼% discount; between 100 and 200, 2% discount; over 200, 2½% discount.

However, trades differ in this matter. If a builder went into a builder's merchants to buy a bath he would normally get credit. If your small local garage owner had to fit a new part to your car, say a Ford, he would go to the nearest Ford main dealer – with whom he may even have an account – and purchase the part. He would get trade discount unless the item or items were particularly small, such as the purchase of two washers. Do bear in mind that such discounts are offered to traders in the normal course of business.

Whether or not a company decides to operate a system of discounts depends entirely upon the nature and terms of its general trade.

(b) Cash Discount

Cash discounts are offered to buyers who pay promptly for the goods they have bought. The normal terms of sale in a trade may be on a monthly account basis, where goods are invoiced during the course of a particular month and a statement sent at the end of that month for settlement by the buyer. The seller normally offers a discount for settlement before the due date, and here again discounts may be graduated according to the speed with which the account is settled. For example, under a monthly account system the seller may be prepared to offer a cash discount of 2% for payments received within 7 days of the date of the invoice, and 1% for payments received within 14 days of the date of invoice. This type of policy may be linked with that of "early cash recovery".

Cash discounts of this nature are sometimes called **settlement discounts**.

Single and Multiple Price Arrangements: Differential Pricing

A single-product price structure is devised on the basis of a policy which will be drawn up in accordance with factors already mentioned. If the product is a mass mover, the success of the pricing policy depends entirely upon the ability of the company to distribute many units.

If sales of the product are negotiated on the basis of individual units, or a small number of units per order, the approach may be varied according to the characteristics of the individual buyer. The pricing of a single type of product may be conducted on the basis of its own particular merits.

Multiple pricing involves two aspects: first, offering the same goods to different buyers at different price levels; second, price arrangements relating to a number of different items, the sales of which are normally achieved in similar quantities and in similar demand centres. A manufacturer might produce a particular product which is found to be successful in, for example, south-east England, and wish to sell it in north-east England. Since the market has already been secured in the south-east on the basis of a particular price, this need not be changed; but it might be necessary, in order to attract the initial demand, to offer the product to the north-east at a lower price. Because various demand areas will often be at different stages of development, it is possible that several different prices are being paid for the same product.

When a manufacturer is marketing a range of products, possibly under a single brand name, it is important to ensure that price concessions in one particular product are reflected in the other products in that range. The reason for this is that the manufacturer is competing with others not only in respect of each individual product, but also in respect of the brand range as a whole.

Pricing Short-Life Products

The difficulty with the pricing of short-life products is that, as their name suggests, they have a very short life-cycle during which a profit can be made. Examples of this type of item include commemorative items produced for a special occasion, such as the Queen's Silver Jubilee, or items which quickly become out-of-date, such as diaries or calendars. An example from the financial world would be National Savings Certificates, which have to have their price fixed in terms of the interest rate return offered. As long as the prevailing level of market interest rates does not change, then the current issue of NSC's should not be over- or under-competitive. However, a change in rates often leads to a completely new issue at a different rate of interest.

Consideration needs to be given to the price charged in view of the product's short life; it is often necessary to be able to charge a premium to reflect this. In the case of products which are produced as part of a limited edition, such as collectors' plates or prints, it is usually the case that a sufficiently low number produced will give the item sufficient rarity value to enable the premium to be charged. This gives rise to a further problem in deciding how many should be produced to maintain this rarity value.

Pricing Special Orders

Special orders usually arise in one of two situations:

- where a firm has no regular work and relies on its ability to win jobs at tender or in the general market place. Examples would include architects and other professional firms as well as many sub-contract firms, particularly those in the building and engineering sectors.
- where a firm has spare capacity over and above its normal level of operations. One example of this would be a bakery producing 2,000 loaves of bread a day with a capacity of 2,500 loaves.

In the first category, firms will tend to take a much longer view of the decision on whether or not to take special orders because this is their standard type of work. In the latter category, firms will be able to take a much shorter-term view and use the concept of minimum pricing to decide on whether or not to take the work on.

Minimum pricing basically involves calculating the break-even position of the work if it is undertaken and then pricing accordingly to cover the incremental cost of the work plus an allowance for profit. How much this allowance is will depend on how much spare capacity is available and the level of fixed costs that must be covered by the firm overall.

Study Unit 11

Budgetary Control

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INTRODUCTION

This study unit, and the four that follow, will concentrate on the use of budgetary control and standard costing as an aid to managing the business.

It is necessary to be able to set targets and then be able to compare performance accurately against them. Without this process it is impossible to determine whether the business is functioning properly. In addition, where differences do occur, it is possible to investigate them and take remedial action.

Budgetary control involves everyone in the organisation and it is therefore an excellent way of communicating and ensuring they are aware of what is expected. This first study unit considers how useful budgets are in more detail and the usual procedures that are followed in terms of budget implementation. We shall also look at a numerical example of how a budget is put together. Do not be concerned that this example is manufacturing-based; the description of the people and products involved will vary from industry sector to industry sector, but the basic principles laid down will usually apply.

There are several different budgetary methods which can be employed and these will be looked at in more detail in the next study unit. Thereafter the applications of standard costing and resultant variance analysis will be considered.

A. DEFINITIONS AND PRINCIPLES

Budgets

The CIMA definition of a budget is:

> *"A plan quantified in monetary terms, prepared and approved prior to a defined period of time, usually showing planned income to be generated and/or expenditure to be incurred during that period and the capital to be employed to attain a given objective."*

A budget is therefore an agreed plan which evaluates in financial terms the various targets set by a company's management. It includes a forecast profit and loss account, balance sheet, accounting ratios and cash flow statements which are often analysed by individual months to facilitate control.

Budgets are normally constructed within the broader framework of a company's long-term strategic plan covering the next five and ten years. This strategic plan sets out the company's long-term objectives, whilst the budget details the actions that must be taken during the following year to ensure that its short- and long-term goals are achieved.

Budgetary Control

The CIMA definition of budgetary control is:

> *"The establishment of budgets relating the responsibilities of executives to the requirements of a policy, and the continuous comparison of actual with budgeted results, either to secure by individual action the objective of that policy or to provide a basis for its revision."*

Companies aim to achieve objectives by constantly comparing actual performance against budget. Differences between actual performance and budget are called **variances**. An adverse variance tends to reduce profit and a favourable variance tends to improve profitability.

Budgetary control therefore allows management to review variances in order to identify aspects of the business that are performing better or worse than expected. In this way a company will be able to monitor its sales performance, expenditure levels, capital expenditure projects, cash flow, and asset and liability levels. Corrective action will be taken to reduce the impact of adverse trends.

The financial aspects of budgets are prepared in the same format as the company's profit and loss, balance sheet and cash flow statements. In this way it is easy to compare actual and budgeted results and calculate variances.

Here is a typical statement comparing actual and budgeted results:

PROFIT AND LOSS ACCOUNT – MAY 200X

Description	**Month**					**Year to Date**				
	Budget		Actual		Variance	Budget		Actual		Variance
	£	%	£	%	£	£	%	£	%	£
Sales										
Tickets										
Catering										
Souvenirs										
Other										
Total										
Gross Profit										
Tickets										
Catering										
Souvenirs										
Other										
Total										
Overheads										
Staff										
Rent										
Local authority tax										
Electricity										
Gas										
Cleaning										
Repairs										
Renewals										
Advertising										
Entertainment										
Commissions										
Laundry										
Motor expenses										
Total										
Net Profit										

You can see that this statement details the month's performance together with that for the year to date. It covers the whole company and in order to obtain even greater control it is necessary to prepare operating statements evaluating the contribution from each area of the business. These additional statements usually cover the activities of individual managers, to identify which of them are failing to achieve their targets. A typical style of operating statement is presented below:

OPERATING STATEMENT

Maintenance Department

Month of May 200X

Description	**Month**			**Cumulative**		
	Budget	**Actual**	**Variance**	**Budget**	**Actual**	**Variance**
	£	£	£	£	£	£
Salaries	16,000	15,500	500	70,000	67,000	3,000
Wages	51,000	53,000	(2,000)	250,000	255,000	(5,000)
Indirect materials	2,000	1,900	100	10,000	12,000	(2,000)
Maintenance	6,000	6,000	–	24,000	23,900	100
Electricity	8,000	10,000	(2,000)	40,000	39,000	1,000
Gas	6,500	7,000	(500)	26,500	28,000	(1,500)
Total	89,500	93,400	(3,900)	420,500	424,900	(4,400)

This statement includes all expenditure under the control of the maintenance manager. It details expenditure for the month of May and the cumulative position for the year to date. The statement identifies the month's main areas of overspend as wages, electricity and gas. For the year to date the main problem areas are wages, indirect materials and gas.

Under a system of budgetary control the maintenance manager will be asked to prepare a report explaining **all** variances and the action being taken to bring the department back onto budget. These actions will be monitored in the following months to ensure that corrective measures have been taken.

Advantages to be Derived from Budgetary Control Systems

(a) Agreed Targets

Budgets establish targets for each aspect of a company's operations. These targets are set in conjunction with each manager. In this way managers are committed to achieving their budgets. This commitment also acts as a motivator.

(b) Problems Identified

Budgets systematically examine all aspects of the business and identify factors that may prevent a company achieving its objectives.

Problems are identified well in advance, which in turn allows a company to take the necessary corrective action to alleviate the difficulty. For example, a budget may indicate that the company will run short of cash during the winter period because of the seasonal nature of the service being provided. By anticipating this position the company should be able to take corrective action or arrange additional financing.

(c) Scope for Improvement Identified

Budgets will identify all those areas that can be improved, thereby increasing efficiency and profitability.

Positive plans for improving efficiency can be formulated and built into the agreed budget. In this way, a company can ensure that its plans for improvement are actually implemented.

(d) Improved Co-ordination

All managers will be given an outline of the company's objectives for the following year. Each manager will then be asked to formulate plans so as to ensure that the company's overall objectives are achieved.

All the managers' plans will be combined and evaluated so that a total budget for the company can be prepared. During this process the company will ensure that each individual plan fits in with the company's overall objectives.

(e) Control

It is essential for a company to achieve its budget. Achievement of budget will be aided by the use of a budgetary control system which constantly monitors actual performance against the budget. **All variances will be monitored and positive action taken in order to correct those areas of the business that are failing to perform**.

(f) Raising Finance

Any provider of finance will want to satisfy itself that the company is being managed correctly and that a loan will be repaid and interest commitments honoured. The fact that a company has established a system of budgetary control will help to demonstrate that it is being managed correctly. The budget will also show that the company is able to meet all its commitments.

Types of Budget

There are a number of different types of budget covering all aspects of a company's operations. These can be summarised into the following categories:

(a) Operating Budgets

Master budgets cover the overall plan of action for the whole organisation and normally include a budgeted profit and loss account and balance sheet. The master budget is analysed into **subsidiary budgets** which detail responsibility for generating sales and controlling costs.

Detailed schedules are also prepared showing the build-up of the figures included in the various budget documents.

(b) Capital Budgets

These budgets detail all the projects on which capital expenditure will be incurred during the following year, and when the expenditure is likely to be incurred. Capital expenditure is money spent on the acquisition of fixed assets such as buildings, vehicles and equipment.

The capital budget enables the fixed asset section of the balance sheet to be completed and provides information for the cash flow budget.

(c) Cash Flow Budgets

This budget analyses the cash flow implications of each of the above budgets. It is prepared on a monthly basis and includes details of all cash receipts and payments. The cash flow budget will also include the receipt of finance from loans and other sources, together with forecast repayments.

B. THE BUDGETARY PROCESS

Timetable

Each company prepares its budgets at a specific time of the year. The process is very time-consuming and allowance must be made for:

- Each manager to prepare estimates
- The accumulation of the managers' estimates so that a provisional budget can be built up for the whole company
- The provisional budget to be reviewed and any changes to be agreed

A large company with a January to December financial year will therefore probably commence its budget preparation in August of the preceding year. This will allow 4-5 months for the work to be completed. If it is to be completed successfully, it is essential that a timetable is prepared detailing what information is required and the dates by which it must be submitted. The preparation of budgets is a major project and it must be managed correctly.

Organisation

As we have just said, the preparation of budgets is a very important task which is given a high level of visibility within the company. The overall co-ordination of the budgeting process is therefore handled at a high level.

Budgeting may be the responsibility of the Finance Director, who will have responsibility for bringing together the directors' and managers' initial estimates. The Finance Director will specify the information that is required and the dates by which it is required. He/she will also circulate a set of economic assumptions so that all directors and managers are preparing their forecasts against the same economic background.

The Finance Director will eliminate most of the obvious inconsistencies from the initial estimates and submit a preliminary budget to the Chairman of the company and its Board of Directors. The Board will then consider the overall framework of this preliminary budget, to ensure that the budget is acceptable and that it gives the desired results.

The Board must also ensure that the budget is realistic and achievable. If the Board does not accept any part of the budget then it will be referred back to the relevant managers for further consideration.

Some companies set up a **budget committee** to co-ordinate the budgeting process. This committee carries out similar functions to those we described above, but will involve more of the company's senior directors and managers. The committee will probably be chaired by the Chairman of the company.

The final budget must be accepted by the Board of Directors. It will then form the agreed plan for the following year against which the company will be monitored and controlled.

Preparing a Budgeted Profit and Loss Account

The following data will need to be converted into a budgeted profit and loss account which should be analysed to individual months and prepared in the same format as the company's management accounts.

There will also be detailed operating statements which allocate costs to individual managers. These statements are also prepared on a monthly basis so that actual expenditure can be compared with budget.

In preparing the budgeted profit and loss account, note that a company's financial performance will be constrained by what are known as **limiting factors**. These include:

- Demand for products
- Supply of skilled labour
- Supply of key components
- Capacity or space

Each of these constraints limits the company's ability to generate sales and profits. Sales cannot exceed the demand for its products, and production cannot exceed the limits imposed by labour and material availability and capacity.

It is essential that a company recognises the fact that it may have a limiting factor, as this will govern the overall shape of its budget.

(a) Sales

Sales budgets are normally prepared by the company's marketing department. The sales budget of a small company may be set by its managing director working in conjunction with the sales team. The sales budget will take into account the following factors:

- What is the sales trend for each product/service? Are sales increasing or decreasing and why?
- Will any new product/service be launched and when?
- Will any of the existing products/services be phased out?
- What price increases can be obtained during the year?
- What is the advertising and promotional budget likely to be?
- What will be the pattern of sales throughout the period covered by the budget?
- What will the company's competitors be doing?

  Are they introducing new products?

  What is their pricing policy?

  Are they being aggressive in order to gain market share?

  What is their advertising expenditure likely to be?

  Are there any new competitors entering the market?

(b) Cost of Sales

Having established a preliminary sales budget, it is now necessary to calculate the cost of sales.

From the standard costs within a standard costing system, most companies know how much each of their products costs to produce. These costs must be updated to allow for the forecast level of price increases and proposed changes to specifications or methods. Hence budget formation and control and standard costing often operate side by side.

(c) Labour Costs

Labour costs will be calculated by multiplying the number of people required to complete the budget by their rates of pay. Full allowance will have to be made for any planned wage increases.

(d) Overheads

The sales budget will be circulated to all managers with responsibility for controlling costs. This document will enable each manager to understand the proposed scale of the company's operations. Each manager will consider the items of expenditure that must be incurred in order to ensure that the company can achieve its sales targets.

Each manager should understand the cost of running his or her area and from this information should be able to estimate the cost levels required for the budget year. By accumulating all the managers' individual estimates it is possible for the company to build up a total cost budget.

(e) Profit before Tax

Sales – Cost of sales – Overheads = Profit before tax

(f) Taxation

From the budgeted level of profit the company will be able to calculate the level of corporation tax payable.

(g) Dividends

Dividends will be budgeted based on the forecast level of profits and the company's overall financial policy.

(h) Retained Earnings

Profit before tax – Tax – Dividends = Retained earnings.

Retained earnings will be added to the balance sheet reserves.

Preparing a Budgeted Balance Sheet

Having completed a budgeted profit and loss account it is now necessary to complete a budgeted balance sheet.

(a) Fixed Assets

Capital Budgets

Each manager will be asked to submit details of capital expenditure requirements, together with a brief summary of the reasons why the expenditure is necessary. A more detailed appraisal will be required before the expenditure is actually committed, using for example, Discounted Cash Flow techniques.

The capital budget will include items such as:

- New buildings
- Machinery and equipment

- Office equipment
- Computers
- Commercial vehicles
- Motor cars

The sum total of all the managers' capital expenditure requirements will form a provisional capital budget.

Disposals

Fixed assets may be sold or dismantled during the year. These will be listed and an estimate made of any sales proceeds that may arise.

If a company sells a fixed asset for more than its net book value then a profit will be made. A loss will result if an asset is sold for less than its net book value.

Depreciation

The first step in completing budgeted depreciation is to calculate the charge for the year on the assets already owned by the company. This will require the company to examine each of its assets and calculate the depreciation charge.

All companies are required to keep a fixed asset register, which includes details of all their fixed assets. Many companies have computerised their fixed asset registers, which improves considerably the speed with which this part of the budgeting process can be completed.

A company must also calculate the depreciation charge on the projects included in its capital budget.

A total depreciation charge can then be derived.

Net Book Value

We can now see how a company can complete the fixed asset section of its budgeted balance sheet. Here is an example:

	Cost	**Depreciation**	**Net Book Value**
	£	£	£
Balances as at 1 Jan	125,000	(35,000)	90,000
Asset disposals	(7,000)	6,000	(1,000)
Depreciation		(12,000)	(12,000)
Additions	55,000	(2,000)	53,000
Balance as at 31 Dec	173,000	(43,000)	130,000

(b) Working Capital

Stocks

Companies calculate stock turnover ratios in order to monitor their stock control function. The formula for calculating stock turnover is:

$$\text{Stock Turnover} = \frac{\text{Cost of Sales}}{\text{Average Stock}}$$

Companies strive for a high stock turnover, which means they are carrying low stocks and managing the function effectively. It is therefore possible to target improved performance by setting a higher stock turnover target for the following year which can be converted into a stock valuation by adopting the following formula:

$$\text{Budgeted Average Stock} = \frac{\text{Budgeted Cost of Sales}}{\text{Stock Turnover}}$$

Debtors

A company will also calculate debtors' ratios in order to monitor the effectiveness of its credit control function. From these ratios a company will establish target ratios which can be used to calculate budgeted debtors in a similar way to the above stock calculation.

$$\text{Debtors Ratio} = \frac{\text{Debtors}}{\text{Credit Sales}} \times 365 \text{ days}$$

$$\text{Budgeted Debtors} = \frac{\text{Debtors Ratio} \times \text{Credit Sales}}{365}$$

Cash in Hand and Cash in Bank

In practice the budgeting process will use cash as the balancing figure in the balance sheet. This approach may seem strange but if you think about it, you will see that a company's cash position will be the result of everything else that the company does.

Creditors

Creditors will be calculated in a very similar way to the above debtors calculation. A target creditors ratio will be determined, which will then be applied to the purchases figure derived from other parts of the budgeting process.

$$\text{Creditors Ratio} = \frac{\text{Creditors}}{\text{Credit Purchases}} \times 365 \text{ days}$$

$$\text{Budgeted Creditors} = \frac{\text{Creditors Ratio} \times \text{Credit Purchases}}{365}$$

Bank Overdraft

The cash budgeting process may indicate that a bank overdraft will be required.

(c) Share Capital

The value of a company's share capital will only change if new shares are issued. This decision will be taken at the highest level within a company.

(d) Reserves

The opening balance on reserves will be known. The final figure will be the opening balance plus or minus the value of retained earnings taken from the budgeted profit and loss account.

(e) Loans

The opening position will be known. The final figure will be the opening position plus the value of any new loans less the value of loans repaid.

(f) Budgeted Balance Sheet

All the preceding data will be presented in the same format as the company adopts for its monthly accounts. This statement will also be prepared on a monthly basis to facilitate comparison with actual results.

Budget Review

The company has now completed provisional profit and loss, capital, cash flow and balance sheet budgets.

The provisional budget will be considered by the Board of Directors. The Board must satisfy itself that the budget is achievable and that it is consistent with the company's overall strategy. If the Board accepts the budget it will become the standard by which the company will be monitored throughout the following year. If the Board does not accept part of the budget then it will be referred back to management for further work.

In large groups of companies, the budget will also have to be approved by the Board of the company's holding company.

Control by Correction of Adverse Variances

The budget will detail all aspects of the company's operations. The company will prepare monthly profit and loss accounts, operating statements, cash flow statements and balance sheets. Each of the figures in these documents will be compared with the budget.

Variances will be calculated (which are the differences between actual and budgeted results). Excessive costs and inadequate sales will be highlighted and positive action will be required in order to ensure that the company corrects any adverse variances.

C. BUDGETARY PROCEDURE

To show the general principles of budget preparation, we shall now work through an extended example which illustrates the typical budget procedure – complete with problems. We shall start with the basic information from which the budget will be built.

Budgetary Control Data

Venture Ltd produces two products – X and Y. The products pass through two departments – department 1 and department 2.

The following standards have been prepared for direct materials and direct wages:

	Product	
	X	**Y**
Material A	5 kg	8 kg
Material B	4 kg	9 kg
Direct labour:		
Department 1	3 hours	2 hours
Department 2	2 hours	4 hours

The standard costs for direct material and direct labour are as follows:

Material A:	£2.00 per kg	
Material B:	£1.20 per kg	
Direct labour:	Department 1	£3.00 per hr
	Department 2	£3.50 per hr

Standard selling prices are:

Product X: £50.00 per unit

Product Y: £80.00 per unit

The budgeted sales for each product for the coming year are:

Product X: 8,000 units

Product Y: 10,000 units

The company plans to increase the stocks of finished goods, so that the closing stock of product X will be 2,000 units and the closing stock of product Y will be 3,000 units.

Opening stocks of finished goods are:

Product X: 1,000 units

Product Y: 2,000 units

Finished goods are valued at variable production cost.

Opening stocks of direct material are:

Material A: 12,000 kg

Material B: 15,000 kg

The required closing stocks of materials are:

Material A: 19,000 kg

Material B: 15,000 kg.

Variable overhead rates are as follows.

	Rate per direct labour hour	
	Dept 1	**Dept 2**
	£	£
Light, heat, power	0.20	0.20
Consumable stores, indirect materials	0.40	0.30
Indirect wages	0.30	0.50
Repairs and maintenance	0.20	0.30

Standard variable selling and distribution expenses are as follows.

	Rate per £ of sales value	
	Product X	**Product Y**
	(%)	*(%)*
Commission	5	5
Carriage, packing, despatch	4	2.5
Telephone, postage, stationery	2	2

Fixed production, selling and distribution and administration overheads are budgeted to be as follows:

	Production	Selling and Distribution	Administration
	£	£	£
Salaries:			
Dept 1	10,000		
Dept 2	12,000		
Selling and distribution:			
Product X		20,000	
Product Y		30,000	
Administration			22,000
Depreciation:			
Dept 1	20,000		
Dept 2	22,000		
Selling and distribution:			
Product X		5,000	
Product Y		6,000	
Administration			6,000
Stationery, postage, telephone:			
Dept 1	1,100		
Dept 2	1,200		
Selling and distribution:			
Product X		800	
Product Y		1,000	
Administration			2,500
Sundry expenses:			
Dept 1	1,400		
Dept 2	1,300		
Selling and distribution:		1,200	
Product X			
Product Y		1,500	
Administration			1,500

The company's balance sheet at the beginning of the year was as follows:

	£	£
Fixed assets at cost		1,000,000
less Accumulated depreciation		200,000
		800,000
Current Assets		
Stock: material	42,000	
finished goods	145,000	
Debtors	150,000	
Cash	40,000	
	377,000	
Current Liabilities		
Creditors	110,000	
Net current assets		267,000
		1,067,000
Represented by:		
Share capital		800,000
Reserves		267,000
		1,067,000

The budgeted cash flows per quarter are:

	Quarter			
	1	**2**	**3**	**4**
	£	£	£	£
Debtors	250,000	200,000	300,000	300,000
Creditors	110,000	100,000	102,000	120,000
Wages	90,000	90,000	92,000	92,000
Expenses	83,000	84,000	87,000	88,000

From this information, we shall now work through the preparation of the following budgets:

- Sales
- Production
- Materials purchases
- Direct materials cost

- Direct labour cost
- Production overheads
- Selling and distribution overheads
- Administration overheads
- Trading and profit and loss account
- Balance sheet at year-end

Sales Budget

The sales budget will frequently be the starting point of the budgeting process, and it is in this case. The sales figures will usually determine the **production requirements** – subject, as in this case, to any required adjustment to the stocks of finished goods. The sales budget will be derived from salespeople's reports, market research, or other intelligence or information bearing on future sales levels and demand for the company's products. The sales budget would be analysed according to the regions or territories involved, with monthly budget figures for territories, salespeople and products, so that sales representatives would have specific targets against which actual performances could be measured.

The total sales budget in terms of units and values for the two products will be as follows:

Product	**Units**	**Unit Price**	**Sales Value**
		£	£
X	8,000	50.00	400,000
Y	10,000	80.00	800,000
			1,200,000

Production Budget

The purpose of this budget is to show the **required production** for the coming year, so that production scheduling can be completed in advance, and individual machine loading schedules can be prepared. This will enable the production department to assess the budgeted usage of plant, the labour requirements and the extent of any under- or over-capacity. As with the sales budget, the total annual requirements must be analysed into monthly figures.

The total production budget for the year is:

	Product	
	X	**Y**
	units	*units*
Sales	8,000	10,000
plus Closing stock required	2,000	3,000
	10,000	13,000
less Opening stock	1,000	2,000
Production requirement	9,000	11,000

Materials Purchase Budget

This budget sets out the **purchasing requirements** for each type of material used by the organisation, so that the purchasing department can place orders for deliveries, to take place in accordance with production requirements – the essential need being that production shall not be held up for lack of materials. Purchase orders should be placed, and deliveries phased, according to the production schedules, care being taken that no excessive stocks are carried. The standard for the products will also specify the quality of material required, so that the purchasing department will be responsible for obtaining the materials required, of the standard quality.

As with other budgets, the purchasing budget should show the monthly quantities to be purchased, allowing for any lead time in suppliers' deliveries.

	Materials	
	A	**B**
	kg	*kg*
Production: Product X	45,000	36,000
Product Y	88,000	99,000
	133,000	135,000
plus Required closing stock	19,000	15,000
	152,000	150,000
less Opening stock	12,000	15,000
Purchases required	140,000	135,000

Direct Materials Cost Budget

The figures for this budget flow from the materials purchases budget, and they show the **financial implications of the planned purchases,** for purposes of financial control and cash flow requirements.

	Material A	Material B
Purchases required	140,000 kg	135,000 kg
Price per kg	£2.00	£1.20
Cost of purchases	£280,000	£162,000

Note that the quantities for production represent the number of production units in the production budget multiplied by the kg per unit.

Direct Labour Cost Budget

This budget shows the number of direct labour hours required to fulfil the production requirements, and the monetary value of those hours. Departmental figures are given, so that departmental supervisors are made aware of the labour hours and costs over which they are expected to exercise control. Periodic reports would be made to supervisors, showing the output achieved and the relevant standard hours and costs for that output (and, where necessary, the reports required on any significant variances from the standards).

Direct Labour Hours

		Product X			Product Y		
Department	**Units**	**Hours per unit**	**Total hours**	**Units**	**Hours per unit**	**Total hours**	**Combined totals**
1	9,000	3	27,000	11,000	2	22,000	49,000
2	9,000	2	18,000	11,000	4	44,000	62,000

Direct Labour Cost

Department	Hours	Rate £	Total £
1	49,000	3.00	147,000
2	62,000	3.50	217,000
	111,000		364,000

Production Overhead Budget

The variable and fixed overheads are shown by department. The departmental supervisors will be expected to exercise control over those items for which they are responsible, and monthly reports, highlighting the variances from budget, will be provided to assist them. The variable overheads are expressed as amounts per direct labour hour – but these could also be shown in relation to some other factor, such as machine time, units of production, materials to be consumed, or other relevant factors. In practice, a combination of these factors might be used.

Variable Overheads

	Department 1 (Direct lab. hours 49,000)		**Department 2** (Direct lab. hours 62,000)	
	£ per hour	*£*	*£ per hour*	*£*
Light, heat, power	0.20	9,800	0.20	12,400
Consumable stores, indirect materials	0.40	19,600	0.30	18,600
Indirect wages	0.30	14,700	0.50	31,000
Repairs, maintenance	0.20	9,800	0.30	18,600
		53,900		80,600

Fixed Overheads

	Department 1	**Department 2**
Salaries	10,000	12,000
Depreciation	20,000	22,000
Stationery, postage, telephone	1,100	1,200
Sundry expenses	1,400	1,300
	32,500	36,500

Selling and Distribution Overheads Budget

As with other overhead budgets, the object of this budget is to **identify the overheads to be controlled** by the management – in this case, the sales management. Further analyses of the overheads would be required to show the budgeted costs on a monthly basis, and by regions and representatives where appropriate.

Variable Overheads

	Product X		Product Y	
Sales	£400,000		£800,000	
	% of sales	£	*% of sales*	£
Commission	5	20,000	5	40,000
Carriage, packing, despatch	4	16,000	2.5	20,000
Telephone, postage, stationery	2	8,000	2	16,000
		44,000		76,000

Fixed Overheads

	Product X £	Product Y £
Salaries	20,000	30,000
Depreciation	5,000	6,000
Stationery, postage, telephone	800	1,000
Sundry expenses	1,200	1,500
	27,000	38,500

Administration Overheads Budget

The administration overheads are likely to be mainly of a fixed character, and not affected by production or sales levels, except where there are wide fluctuations. These overheads will cover the general administration and accounting services of the organisation, and they will be the responsibility of the chief executive concerned. Separate budgets for the accounting company secretariat and other departments will be required in larger organisations. The budgets will be prepared after detailed studies have been made of the level of service required to provide the necessary accounting, secretarial and other administrative services needed. Where a complete review is required, an **organisation and methods study** may be undertaken. Monthly reports will show actual and budgeted results, as with other functions, and variances highlighted for further investigation. (The costs in this problem have been assumed to be entirely fixed.)

	£
Salaries	22,000
Depreciation	6,000
Stationery, postage, telephone	2,500
Sundry expenses	1,500
	32,000

Budgeted Trading and Profit and Loss Account

This account is part of the master budget, and it shows the expected trading profit or loss based on the sales and cost budgets previously prepared. In the light of these results, the management may decide to recommend changes to the sales and cost figures, to bring the expected results into line with a required return of capital or gross and net profit percentages related to sales. Once the final figures have been approved, the budgeted trading and profit figures become the target for the company as a whole. Using the figures arising from the previous budgets, the budgeted trading and profit and loss account would be as follows:

Budgeted Trading and Profit and Loss Account
for the year ended 200X

	£	£
Sales		1,200,000
Opening stock of materials	42,000	
Purchases	442,000	
	484,000	
less Closing stock of materials	56,000	
	428,000	
Direct wages	364,000	
Variable production overheads	134,500	
	926,500	
Opening stock of finished goods	145,000	
	1,071,500	
less Closing stock of finished goods *	236,000	835,500
Gross profit		364,500
Overhead expenses		
Variable selling and distribution overhead	120,000	
Fixed overheads:		
Production	27,000	
Selling and distribution	54,500	
Administration	26,000	
Depreciation:		
Production	42,000	
Selling and distribution	11,000	
Administration	6,000	286,500
Net profit		78,000

* Note on value of closing stock of finished goods in Budgeted Trading Profit and Loss Account

This is made up as follows:

2,000 units of X:- Mat A £10.00; Mat B £4.80; Lab 1 £9.00; Lab 2 £7.00;

Variable overheads: Dept. 1 £3.30; Dept. 2 £2.60;

Total: £36.70 each unit × 2,000 = £73,400

3,000 units of Y: - Mat A £16.00; Mat B £10.80; Lab 1 £6.00; Lab 2 £14.00;

Variable overheads: Dept. 1 £2.20; Dept. 2 £5.20;

Total £54.20 each unit × 3.000 = £162.600

Grand Total = £236,000

Budgeted Balance Sheet

This also forms part of the master budget, and it shows the **expected overall financial position** resulting from the budgets. It enables assessments to be made of the return on capital and ratios of profitability and liquidity – for example, the current asset/current liability position, credit collection periods, and other financial ratios. This may also be part of a review process in which some revisions may be required before final approval is given.

Budgeted Balance Sheet as at . . . . .

	£	£
Fixed assets at cost		1,000,000
less Accumulated depreciation		259,000
		741,000
Current Assets		
Stock: material	56,000	
finished goods	236,000	
Debtors	300,000	
	592,000	
Current Liabilities		
Creditors	120,000	
Bank overdraft (+ 40 – 88)	48,000	
	168,000	
Net current assets		424,000
		1,165,000
Represented by:		
Share capital		800,000
Reserves		365,000
		1,165,000

D. CHANGES TO THE BUDGET

Problem of Long-Term Planning

One fact about any forecast is that no person can be sure that the forecast will come true! This means that no manager can be certain that future events will occur as planned or predicted. The further ahead the planning horizon, the less certain the prediction. A classic example of this is trying to forecast the weather, yet the weather affects the fortunes of most businesses – e.g. those involved in the construction industry, retailing, extraction of raw materials, the clothing trade. The future weather pattern is something that must be considered when preparing budgets and other business plans.

Need to Update Budgets

It often happens that, since the time when a budget was prepared, more information about the budget period becomes available. The problem then arises whether to change the budget in the light of additional information or whether to ignore the additional information and leave the original budget alone. To obtain maximum benefit, the management should change the original budget, and produce a **revised budget** which takes account of the changes. The differences between the first and second budgets are caused by the plan being changed, and they are part of the organisation's **planning variances**.

Example

XYZ Plc produces monthly budgets six months in advance. The original budget for Month 6 is summarised as follows:

	£000
Sales	850
Costs	725
Budgeted profit	125

At the end of Month 3, additional information showed that the results for Month 6 would be expected to be different from those budgeted for. XYZ Plc's management decided to update the first budget and produce a new budget, reflecting the expected changes, as follows:

	£000
Sales	825
Costs	750
Budgeted profit	75

Normally, the updated budget is compared with **actual results**, and the original budget is compared with the updated one. The planning profit variance in this example is £125,000 – £75,000 = £50,000 (being the original budgeted profit **less** the updated profit). If more than one update of the budget is needed, each updated budget can be compared with the previous update. The latest updated budget is the one that should be compared with actual results.

The main advantages of updating budgets are that:

- The budget reflects all **known relevant information** about the budget period.
- The management can assess the **reliability of information** used to prepare budgets.
- The ability of the planners to plan properly can be assessed – i.e. the **planners' performance** can be evaluated.
- Operating managers are not held responsible for variances that are caused by the plan being **inaccurate**.

Study Unit 12

Further Budgetary Control Techniques

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INTRODUCTION

This study unit will be looking at budgetary techniques which can be used in a particular set of circumstances. Flexible budgets, for instance, change with changes in the level of activity and attempt to overcome the problems inherent in "static" budgetary systems. Probabilities can be used to good effect where different future scenarios need to be included and "three-tier" budgets can be produced showing the best, worst and most likely outcomes.

Budgetary control in not-for-profit organisations is an important subject and zero-based budgeting is one technique which has specific applications to those types of organisation.

The motivational effect of budgetary control will also be considered during this study unit.

A. FLEXIBLE BUDGETS

The budgets which we have described so far are those which are used to **plan** the activity of the organisation. Cost **control** begins by comparing actual expenditure with the budget. Remember, though, that if the level of activity differs from that expected, some costs will change, and the individual manager **cannot** be expected to control the whole of that change. If activity is greater than budgeted, some costs will rise; if activity is less than budgeted, some costs will fall. The question is whether the manager has kept costs within the level to be expected, given the **activity level**.

A **flexible budget** is one which – by recognising the difference in behaviour between fixed and variable costs in relation to fluctuations in output, turnover, or other variable factors, such as number of employees – is designed to change appropriately with such fluctuations. It is the flexible budget which is used for control purposes, not the fixed budget.

Cost Behaviour

To understand how to prepare flexible budgets, we must recall our earlier definitions of fixed and variable costs:

- **Fixed Cost**

  This is a cost which accrues in relation to the passage of time and which, within certain output and turnover limits, tends to be unaffected by fluctuations in the level of activity. Examples are rent, local authority property taxes, insurance and executive salaries.

- **Variable Cost**

  This is a cost which, in the short term, tends to follow the level of activity. Examples are all direct costs, sales commission and packaging costs.

- **Semi-Variable Cost**

  This is a cost containing both fixed and variable elements, which is, therefore, partly affected by fluctuations in the volume of output or turnover.

- **Discretionary Cost**

  This is a fourth category of cost, which may be incurred or not, at the manager's discretion. It is not directly necessary to achieving production or sales, even though the expenditure may be desirable. An example is research and development expenditure.

Discretionary costs such as this are a prime target for cost reduction when funds are scarce, precisely because they are not related to current production or sales levels. This might be a very short-sighted policy – nevertheless, it is useful to have these costs separately identified in the budget.

- **Controllable Costs or Managed Costs**

  As we know, the emphasis in budgeting is on responsibility for costs (budgetary control is one form of responsibility accounting). The aim must be to give each manager information about those costs he or she can control, and not to overburden him or her with information about other costs. A controllable cost is one chargeable to a budget or cost centre which can be influenced by the actions of the person in whom control of the centre is vested.

  Given a long enough time-period, all costs are ultimately controllable by someone in the organisation (e.g. a decision could be taken to move to a new location, if factory rental became too high). Controllable costs may, however, be controllable only to a limited extent. Fixed costs are generally controllable only given a reasonably long time-span. Variable costs may be controlled by ensuring that there is no wastage but they will still, of course, rise more or less in proportion to output.

Preparation of Flexible Budgets

Example 1

The fixed budget for Budget Centre A is shown below. This is the budget based on the **expected level of output**, and it will therefore be the budget used to plan the resources needed in that department. You will note that the activity level is given in standard hours. The standard hour is a measure of **output**, not of time: it is the quantity of output or amount of work which **should be performed** in 1 hour. This concept is used because it enables us to compare different types of work. Instead of saying "400 units of X which takes 2 hours per unit plus 200 units of Y which takes 1 hour per unit" we can simply say "1,000 standard hours".

Budget Centre A

Budget – Period 3			***Activity 1,000 std hrs***
	Fixed £	**Variable** £	**Total** £
Process labour		2,000	2,000
Indirect labour	50	85	135
Fuel and power	450	800	1,250
Consumable stores	5	15	20
			3,405

From the above figures we can evaluate a level of expense which is appropriate to any level of output, within fairly broad limits. The figures have been set as the total allowance of expense which is expected to be incurred at an output level of 1,000 standard hours. Should, however, the output not be as envisaged, the allowance of cost can be varied to compensate for the change in level of activity. This adjustment is known as flexing a budget for activity.

We would expect that if 1,000 standard hours were produced, the cost incurred would be £3,405. If the level of output changes for some reason, the level of cost usually changes. Let's assume that the levels of output attained were 750 standard hours in period 4 and 1,200 standard hours in period 5. The budgets would be flexed to compensate for the changes which have taken place in the actual output compared with those anticipated:

Budget Centre A

Actual output: 750 std hrs

Budgeted output: 1000 std hrs

Budget – Period 4 ***Production volume ratio 75%***

	Basic Budget			**Flexed Budget**			**Actual**
	Fixed	Variable	Total	Fixed	Variable	Total	
	£	£	£	£	£	£	£
Process labour	–	2,000	2,000	–	1,500	1,500	1,509
Indirect labour	50	85	135	50	64	114	126
Fuel and power	450	800	1,250	450	600	1,050	986
Consumable stores	5	15	20	5	11	16	19

In this instance, the fixed expenses are deemed to have remained the same but the basic budget variable figures have been allowed at only 75% of the full budget. We thus attempt to show that activity has had its effect on cost. For example, we expected that only £1,500 would be expended on process labour for the output achieved but, in fact, we spent £1,509, and we exceeded the allowed cost by £9.

Let's now take the effect on the budget in period 5 of having gained a greater output than that envisaged originally:

Budget Centre A

Actual output: 1200 std hrs

Budgeted output: 1000 std hrs

Budget – Period 5 ***Production volume ratio 120%***

	Basic Budget			**Flexed Budget**			**Actual**
	Fixed	Variable	Total	Fixed	Variable	Total	
	£	£	£	£	£	£	£
Process labour	–	2,000	2,000	–	2,400	2,400	2,348
Indirect labour	50	85	135	50	102	152	193
Fuel and power	450	800	1,250	450	960	1,410	1,504
Consumable stores	5	15	20	5	18	23	19

Here, we have used a factor of 120% as applied to the variable elements of the basic budget. For fuel and power we observe that the fixed element has remained constant, but we have assumed that the variable element of £800, having risen in sympathy with the level of output, will have gone up by 20%, to £960. The flexed budget figure for fuel and power thus becomes £1,410, compared with the basic budget figure of £1,250.

It is clearly more reasonable to compare the actual cost of fuel and power for the period – i.e. £1,504 – with the flexed budget rather than with the basic budget. This explains the entire purpose of flexible budgeting, insofar as it attempts to provide a value comparison between the actual figure of cost and the budget figure.

Comment

Budget Centre A involved a production budget. The flexing for activity was therefore carried out according to different levels of output. The definition of flexible budgets given earlier referred to fluctuations in output, turnover, or other factors. Obviously, the selling costs budget will be flexed according to turnover (i.e. number of units sold) rather than output levels, while the canteen will be flexed according to number of employees.

Example 2

The flexible budget for the transport department of a manufacturing company contains the following extract:

Flexible Budget for Four-Weekly Period

Ton-miles to be run		80,000	100,000	120,000
		£	£	£
Costs:	Depreciation	240	240	240
	Insurance and road tax	80	80	80
	Maintenance materials	160	190	190
	Maintenance wages	120	120	160
	Replacement of tyres	40	50	60
	Rent and rates	110	110	110
	Supervision	130	130	130
	Drivers' expenses	200	400	600
		1,080	1,320	1,570

In the four-weekly period No. 7, the budgeted activity was 100,000 ton-miles but the actual activity was 90,000 ton-miles. The actual expenditure during that period was:

		£
Costs:	Depreciation	240
	Insurance and road tax	80
	Maintenance materials	165
	Maintenance wages	115
	Replacement of tyres	35
	Rent and rates	110
	Supervision	130
	Drivers' expenses	315
		1,190

Prepare a tabulation of the variances from budget in relation to period No. 7.

	Budgeted Activity	**Flexed Budget**	**Actual Expense**	**Expense Variance**
Ton-miles	100,000	90,000	90,000	
	£	£	£	
Expense:				
Depreciation (F)	240	240	240	–
Insurance and road tax (F)	80	80	80	–
Maintenance materials (S-V)	190	190	165	*£25 saving*
Maintenance wages (S-V)	120	120	115	*£5 saving*
Replacement of tyres (V)	50	45	35	*£10 saving*
Rent and rates (F)	110	110	110	–
Supervision (F)	130	130	130	–
Drivers' expenses (V)	400	300	315	*£15 over-spending*
	1,320	1,215	1,190	*£25 saving*

Notes on the Answer

Maintenance materials may cause a little difficulty. There is no indication in the problem at what level of activity the rise from £160 to £190 takes place. From the information given, it could be taken as 80,000 ton-miles or 99,999 ton-miles. You will have to make a decision on which to take – but remember that the level of activity taken in the solution is 80,001 ton-miles and above this level the budgeted expense will be £190.

B. BUDGETING WITH UNCERTAINTY

It is unfortunate but it is almost always the case that the future does not occur as it was envisaged when the budgeting procedure was carried out. Very often the causes of the differences in volume or selling price or any one of a large number of variables that go to make up the budget are the result of factors which are beyond the control of the individual firm.

Thus, the future actions of a foreign government of a country to which a firm exports cannot be assessed with any degree of accuracy. The government in power could fall without warning, it could decide to increase interest rates and thereby affect the exchange rate, it could subsidise home produced competitive goods and so on.

Similarly, social change can also have an effect; in recent years the 'green' revolution has forced many firms to produce their goods in recycled packaging or use materials from a replaceable source. This can cause high initial (and perhaps ongoing) investment in new plant and machinery, more expensive raw materials and so on.

Economic change is perhaps the most common cause of budget changes as it will tend to have a much more direct effect on volume. An increase in interest rates, for example, may cause fewer people to consider buying a new house or car by obtaining a loan to finance the purchase. In the same way changes in taxation relief on home loans could cause similar uncertainty.

We shall now look at a particular impact on budget accuracy, that of technological change.

Effects of Technological Changes on Budgets

(a) Expected Benefits and Costs

In order to appreciate fully the impact of such changes on the budgets, let us detail the benefits that are expected from an increase in levels of automation.

- Savings from having continuous production runs with higher levels of efficiency from the use of tools and equipment. This will often be accompanied by the introduction of shift working.
- Quicker setting up of work.
- A reduction in wastage because standards of quality will be on a consistent basis.
- A reduced level of inspection.
- A reduction in manpower.

The financial burden of such changes is likely to be felt in the heavy capital cost of the equipment; the training of personnel; and possibly in labour problems. There may be resistance to the changes, particularly where certain employees are required to alter the nature of their work.

(b) Relating Benefits and Costs to the Budget Revision

- ***Continuous Production***

  Although it may be possible to calculate the estimated increases in the levels of output with some degree of accuracy, will there be a ready market for these additional units? In other words, can we increase our sales budget absolutely in line with our revised production forecasts? It is possible that, although sales will increase in the short term, the increase will be smaller than the increase in production, and therefore the level of stocks of finished products will rise. This means, of course, that the new levels of finished stocks will necessitate a revision of the budget for the finished stores or warehouses. Also, there could be an effect on our existing staff of salespeople, again calling for changes in the sales budget. There may even be an effect on the volume of work in the accounts department – credit control, etc. This illustrates the need to consider carefully the possible effects of changes in the budget of one department, on the budgets of other departments.

- ***Quicker Setting-Up of Work***

  This should be reflected in a reduction of the budget for the production planning departments, since there will be less frequent demands for the work of forward planning. However, these reductions may not be as significant as supposed, since many of these costs are fixed, certainly in the short term. Also, staff numbers may not actually fall as existing employees may well be replaced by employees of different types or grades.

- ***Reduction of Wastage***

  As this will result in a substantial fall in the use of raw materials, this element of the budget could be reduced with some confidence. We should also consider the possibility of a change in the type or quality of the materials currently in use. It is possible that the new techniques may require the use of materials that are more suitable for this type of processing. This will make the computation of new standard prices necessary.

- ***Reduction in Level of Inspection and Manpower Level***

  Both of these will call for a revision of our manpower budget and of the wages element in the main financial budget. Indeed, the shift working mentioned above will also require a budget revision. Although it may be comparatively easy to quantify such revisions, the implementation of such changes is by no means so easy. If any changes in working conditions or in the activities of employees are contemplated then lengthy negotiations are often required. It is an even greater problem when redundancy is contemplated. We know that employees are offered a great deal of legislative protection against the danger of unfair dismissal and it is essential that the procedures laid down by the law are followed. Inevitably, there will be a considerable passage of time before the full effects of staff reductions are felt and this time-lag must be fully reflected in the budget revision. There is also a strong possibility that redundancy payments will have to be made. Again, these costs, less the proportion that will be refunded by the government, must appear in the revised budget.

- ***Acquisition of New Equipment***

  This involves the capital budget. If the purchases were planned at the start of the trading year, then no revision of the capital budget will be needed. However, the decision to make the change may have been forced on the management at short notice and the call on the capital resources may mean that approved projects will have to be delayed and revisions made. The method of financing is also relevant here. It could be in the form of outright purchase, leasing, hire purchase or perhaps on a straight hire basis. In this last case, the capital budget would not be involved but the revenue budget should include the estimated expenditure. Although one method of financing may have been planned, when the time comes to act, an alternative method may appear to be more attractive. With a change in the method, a revision of the budget becomes necessary.

- ***Costs of Training***

  A degree of planning is demanded before training costs can be shown in the revised budget. These costs will usually form part of the budget of the personnel department and the training officer needs to conduct research into the most suitable form of training to meet the demands of the new technology. The training department may be entering into a field of training that is quite new and initially the training officer must identify the members of the staff who will derive the greatest benefit from such training. It will then be necessary to determine what local facilities are available; from this basic information the training department will be able to assess the budget provisions needed.

(c) Use of Technological Change Variances

When technological changes take place, it is possible to continue the use of the original budgets and to produce technological change variances. To illustrate possible budget revisions that may be required as a result of such technological advances, let us compare the production budget, before and after:

		Original		**Revised**	
		£	£	£	£
Raw materials			300,000		300,000
Wages			200,000		180,000
Direct expenses:	Power	8,000		18,000	
	Depreciation	5,000		25,000	
	Heat and light	10,000		10,000	
	Cleaning	4,000		4,000	
	Telephones	2,000		2,000	
	Stationery	1,000	30,000	1,000	60,000
Allocation of indirect expenses			40,000		60,000
			570,000		600,000
Output *(units)*			100,000		120,000
Cost per unit			£5.7		£5.0

A number of employees have been replaced by advanced types of machinery that require additional power and depreciation charges. Indirect expenses are likely to rise as a result of the use of computer equipment, together with the employment of specialist operations staff.

Effects of Obsolescence on Budgets

If changes have been forced upon the business because of the sudden obsolescence of the existing plant and equipment, special problems will arise. There will be no financial provision in the existing budget to meet this situation and it may not be possible or even desirable to make a sudden change in selling prices. The activities of competitors must be carefully assessed, particularly in respect of the methods of production that they employ. We should revise the whole of our existing budget, looking for ways in which we can effect economies in order to absorb the expense of this sudden commitment. The postponement of certain expenditure until a future date may be possible. After this general study, the budget revision can be made.

C. BUDGET PROBLEMS AND METHODS TO OVERCOME THEM

Inflation and Rolling Budgets

The problem of estimating expected inflation levels has long been one of the fundamental problems in budget setting. The longer the time-scale the more difficult the problem becomes. Thus, a budget for the next 12 months can at least take current levels as a starting-point in the knowledge that, even in volatile times, it is likely to move only a few per cent either way. The further forward one predicts, the more likely the estimates are to be incorrect.

One method sometimes used to try to counteract this uncertainty is rolling or continuous budgets. These operate in such a way that when the end of a particular budgeted period is reached (i.e. month, quarter, year, etc.) a similar period is added to the remainder of the budget so that there is always a budget in existence for, say, twelve months ahead which has been altered to reflect changing conditions. This may be illustrated as follows:

Budget

	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	£	£	£	£	£
Detail					
	______	______	______	______	______
Total					

Figure 12.1: Rolling Budget

At the end of Year 1, the actual figures for that year are known and so the budget for that year falls out and is replaced by the budget for Year 6. At any time therefore, we always have a budget covering a period of the next 5 years.

The main **advantages** of rolling budgets are as follows:

- The company is forced to look at its future plans in detail, at least once a year.
- There is an opportunity given to revise the budget estimates for each of the ensuing years. When we are attempting to make forecasts that relate to 5 years ahead, they are bound to require adjustments as we get nearer to that time.
- There is always a budget extending forward for a fixed period, i.e. twelve months.
- Uncertainty is reduced; fixed budgets may become obsolete due to changing economic conditions. Because rolling budgets are adjusted due to such changes they are likely to be more realistic.
- Planning and control are easier to implement because of reduced uncertainty.

Rolling budgets, however, also have their **disadvantages**:

- More frequent budgeting involves additional time and expense.
- The frequency with which the budgets are updated may lead to a lack of confidence in the budgeting process. If the exercise is carried out once a year it tends to assume prime importance and has the effect of focusing everyone's attention on the information being produced.
- There is no real reason why the existing fixed period budget could not be updated during its life to reflect changing market conditions. Thus, interest rates may have moved to such an extent that by month six a complete revision of those used in the budget is required for months seven to twelve.

Production Volume Uncertainty and Probabilistic Budgeting

The problems of sales forecasting have an effect on budgets. The difficulty faced when setting the budget is determining exactly what levels of output and sales are likely to occur. If, for example, after the budget is set, a new large customer is found (or an old one lost), then the new levels of output required could make the old budget obsolete. One way of overcoming this is to have a budget which assigns **probabilities** to likely levels of sales, output and cost.

As an example, a sales budget may be assigned probabilities as follows:

Sales *(£)*	**Probability**
100,000	0.3
150,000	0.3
200,000	0.2
250,000	0.2

Costs can be estimated for each level of sales and thus the overall contribution found, e.g.

Sales £	**Variable Costs** £	**Contribution (C)** £	**Probability**	**P × C** £
100,000	70,000	30,000	0.3	9,000
150,000	97,500	52,500	0.3	15,750
200,000	120,000	80,000	0.2	16,000
250,000	137,500	112,500	0.2	22,500
				63,250

The expected contribution level is therefore £63,250. It can also be read from the figures that there is a 20% chance of making a contribution of £112,500, but a 30% chance of making a contribution of only £30,000. This method can also be used to consider different scenarios such as testing the likely levels of contribution at different price levels and choosing that which maximises the best possible outcome.

There are two other techniques which can be employed to analyse the uncertainty in a budget. The first is three-tier budgeting whereby three budgets are produced, best possible, worst possible and most likely. The advantage of this, although simple, is that it gives an indication of the potential variations in profitability.

Secondly, there is sensitivity analysis which we also looked at earlier and which basically involves testing the effect on the budget of altering one variable, e.g. what happens if interest rates are actually 2% lower than predicted or material costs increase by 5% more than expected and so on.

The advantage of all three techniques is that they give indications as to the possible range of results which may occur depending on circumstances. It must also be remembered though that the assessments must be based on some premise of reality, otherwise any results produced will be meaningless.

Sub-Optimality and the Use of Management by Objectives (MBO)

We saw earlier that one of the purposes of the budget is to act as a co-ordinating function within the organisation. If different divisions and departments have budgets that are not related to any of the others then sub-optimality may result. One method of overcoming this problem is Management by Objectives (MBO), the stages of which are as follows:

- Individual objectives are set for each manager and each department. This initially takes the form of the managers defining their own objectives and then, after discussions with their supervisor, a final set of objectives is agreed.
- Key tasks are analysed and performance standards agreed.
- The individual and departmental objectives are brought together as divisional plans are reviewed to ensure consistency of approach and intended targets.
- Periodic performance appraisal is undertaken at which the achievements to date of each manager and department are analysed. If performance is found to be below standard, the opportunity may be taken to suggest management training in the area of deficiency.

MBO is also useful for an organisation in that it can be used as a means to identify those individuals with the potential for advancement. It can also form the basis of bonus schemes linked to levels of performance.

The main point to remember about this technique is that it is essentially a two-way process; it is not designed to identify those people who are not performing and then beat them with a stick until they are.

It enables individuals to be involved in setting their own objectives and to receive helpful advice and counselling if they fall short of the required standards. MBO is also very much concerned with motivational aspects of budgeting control which we will come to shortly.

D. ALTERNATIVE BUDGETARY APPROACHES

Zero-Based Budgeting (ZBB)

ZBB starts from the assumption that previous budgets are meaningless in the context of those currently being set and so all budgeting starts at a nil basis from which all expenditure is identified.

The CIMA definition of ZBB is as follows:

> *"A method of budgeting whereby all activities are re-evaluated each time a budget is formulated. Each functional budget starts with the assumption that the function does not exist and is at zero cost. Increments of cost are compared with increments of budget, culminating in the planned maximum benefit for a given budgeted cost."*

An American fostered concept, this definition shows that the benefit to be derived exceeding its cost is a central factor. No activity can automatically assume that funds will continue to be received; it is necessary to prove that any funds that are allocated will achieve a positive benefit for the organisation.

Stages of implementation of ZBB

- ***Definition of Objectives***

  Each area of the organisation is analysed according to its function and is given an objective. In relation to the provision of health care for instance this might include breaking it down into the distinct units of maternity care, psychiatric treatment and so on. Each of these areas then has its own objective.

- ***Decision Units***

  Once the organisation has been broken down into logical units the next step is to analyse it into decision units which are basically any activity for which a decision needs to be made about the resources to be allocated to it. Thus there may, for instance, be several decision units within maternity care which itself is a function of overall health care for which an objective has been set.

- ***Decision Packages***

  Each decision unit has a budget prepared for it by the function concerned which details the resources it requires and the benefits which should accrue. In order for this stage to be effective it is necessary for senior management to provide guidance and assistance in terms of, for instance, expected activity levels and so on.

  Each package will be made up of a "base" package, which details the minimum requirements for the decision unit concerned, and "incremental" packages which are the provision of greater levels of service that the manager concerned considers desirable. In relation to road maintenance, for example, the base package may consist of a request for resources to monitor a certain mileage of roads, and incremental packages may include replacement of kerbstones, resurfacing of a certain number of roads, road bridge strengthening and so on. Each package will have its own budget and analysis of expected benefits.

- ***Evaluation and Ranking of Packages***

  Each package is then ranked in accordance with how important it is considered to be. This may be done by senior management, who are responsible for the overall allocation of resources within the organisation, or by the managers themselves, because, as you can imagine, there is the potential for there to be a vast number of packages under consideration.

One way of deciding on who evaluates what is to have a cut-off limit in terms of spending, such as £10,000; below this the ranking is carried out by the managers concerned and above this figure it is the responsibility of senior management.

Each base package should be ranked as the highest priority for that particular decision unit with each of the incremental packages ranked in descending order of importance.

Evaluation will be carried out using Cost-Benefit Analysis (CBA) based on the overall level of resources available. It is possible therefore, that one decision unit may have all its decision packages ranked high enough to be accepted; another unit may receive only a portion because its expected benefits in terms of cost are ranked lower overall.

- ***Allocation of Resources***

  Once the evaluation has taken place, the resources available can then be allocated accordingly.

Advantages

- The allocation of scarce resources should be carried out much more efficiently because of the practice of ranking each decision package.
- The traditional problem of slack being built into incremental budgeting exercises should be eradicated because each request for funds starts from a "zero-base" and has to justify itself.
- Inefficient operations, i.e. those whose costs exceed their benefits, can be much more easily identified, and, if necessary, excluded.
- Past inefficiencies that have been built into the budget are excluded.
- Because there is much more involvement in this type of process, those involved should experience a higher level of motivation towards budget achievement.
- It is possible to apply the process selectively to those areas where scarceness of resources poses the greatest problem.

Difficulties encountered

- There is a large volume of extra work associated with starting the budgeting process from scratch in each new period.
- It is a radical idea, which, because of its emphasis on efficiency, can cause conflict within some organisations, especially those which have practised traditional budgeting techniques for many years.
- There is the difficulty of deciding on benefits derived under Cost-Benefit Analysis.
- If major changes to the organisation occur during the budgeting year, the original CBA can be radically altered and may well become out of date. Thus, packages which were originally accepted might be rejected if the analysis were to be undertaken again and vice versa.
- There could also be a lack of continuity if a package which is accepted in one period is rejected in the following. This can be overcome by making sure that a package is used as a "base" and therefore obtains a higher priority. An example would be the construction or widening of a major road which obviously started should be completed or the earlier work undertaken will lose its usefulness.

ZBB, despite its many advantages, is much less widespread in the UK than it is in the United States, possibly because of the large amount of extra work involved and the much more "traditional" outlook of British companies.

Note that ZBB as a technique is generally applicable to profit-seeking as well as not-for-profit (NFP) organisations.

Activity-Based Budgeting

This is based on an amalgam of various planning and budgeting techniques such as priority-based budgeting (itself a derivative of zero-based budgeting) and activity-based costing. It also forms a link between planning and budgeting.

The process begins with the breaking down of the strategic plan into plans or objectives for individual business units and, by the use of activity analysis, into plans for the individual activities themselves. Minimum levels of activity are analysed as are incremental levels and key constraints are identified which in turn leads to the quantification of resource requirements. Critical success factors are also an important element in the process and once these are known, performance indicators can be set for them to determine how the company is performing in comparison to its activity-based budget. The technique also provides a method of feedback to the updating of strategic plans.

The advantages claimed for the process are similar to those for activity-based costing:

- Identification of inefficient processes and unprofitable products is made easier.
- Elimination of non-value-added activities.
- Enhanced performance measurement and control.
- There is better control over the causes of cost by identifying them with the activities they result from.
- It provides the ability to view the organisation from a different perspective that cuts across traditional departmentalisation.

Incremental Budgeting

This is the traditional method of budgetary control which uses the previous year's budget as the basis for the current year's budget, usually with an allowance for change due to inflationary activity or efficiency. The approach therefore assumes that the basis of the current budget is correct. The disadvantages of such an approach, particularly when compared to the previous two budgeting methods are as follows:

- There is no focus on the efficient use of resources by identifying the activities they emanate from.
- Because the change in the budget can be somewhat arbitrary, it is often the case that cuts are made with regard to overall constraints rather than by identification of inefficient products or processes.
- The link with the strategic plan is often non-existent.
- A further result of its arbitrary nature is that commitment on the part of those responsible for budget achievement may be low.
- New activities can tend to be constrained, again because of the overall rigidity of the technique.

Budgeting and TQM

Modern approaches to methods of work such as Total Quality Management have resulted in radical changes in budgetary processes. TQM is an overall concept that attempts to ensure that the highest quality output is produced with minimum defects. It involves everyone in the organisation. The budgeting system can be very effective in providing the data to assess how effectively TQM is operating; budgets can be set for departments, particularly in terms of quality related costs such as internal failure, re-working or prevention costs, variances against which will indicate if TQM is operating properly or not.

In addition, as TQM involves everyone, individual targets can be set within the overall departmental budgets so that each person can assess his or her own contribution.

E. BEHAVIOURAL ASPECTS OF BUDGETING

Reaction of Managers to Budget Levels

The budgeting exercise is, very often, seen more importantly as a planning mechanism whereby the desired levels of cost, expenditure and so on are decided upon for the forthcoming period. Once the budgets are set, however, they are transformed into a mechanism for controlling the activities of the organisation by comparing actual results with those to which the organisation originally aspired.

How effective that control is depends very much on what those aspirations were in terms of difficulty of achievement and the viewpoints of the individual managers concerned. Research was undertaken by **Atkinson** which suggested that managers would aspire to one of two levels:

(a) If the desire is to achieve success rather than avoid failure, then budgets set which are too difficult or too easy act as demotivators, whereas those of middling difficulty provide the highest levels of motivation.

(b) If the desire is to avoid failure rather than achieve success, then budgets of even middling difficulty will not motivate the manager concerned. Only those with an easy level of difficulty will be attempted, and anything else will not even be considered.

Under (b) above, the levels of performance are lower than under (a). Further analysis by **Hopwood** of the original research suggested that two different budgeting levels could be implemented; one for expected levels of performance which would be the planning budget, and one for aspired levels of performance, which would act as the control budget.

There are several variations that can be employed on this basis:

- Using the expected budgets at operational planning levels, and the target budgets for management control further up the hierarchy.
- Budgeting on a target basis for control, but using planning variances to convert the target to an expected actual level.

Care must be taken, however, where two different budgets are produced; the duplication of the original work and the information being produced having a tendency to alienate those involved. In addition, managers may, effectively, disregard their target levels, believing that the achievement of expected levels only is satisfactory.

Motivation of Staff

Motivation can be defined as the reason why a person acts in a certain way; ideally the actions he or she undertakes to achieve personal ambitions will be commensurate with the attainment of the overall goals of the organisation. In order to be able to assess the best ways of motivating an individual, and understanding why motivation may be absent, we will begin by briefly examining some motivational theory.

(a) Maslow

In his work "*Motivation and Personality*", Maslow put forward the idea of the "hierarchy of needs":

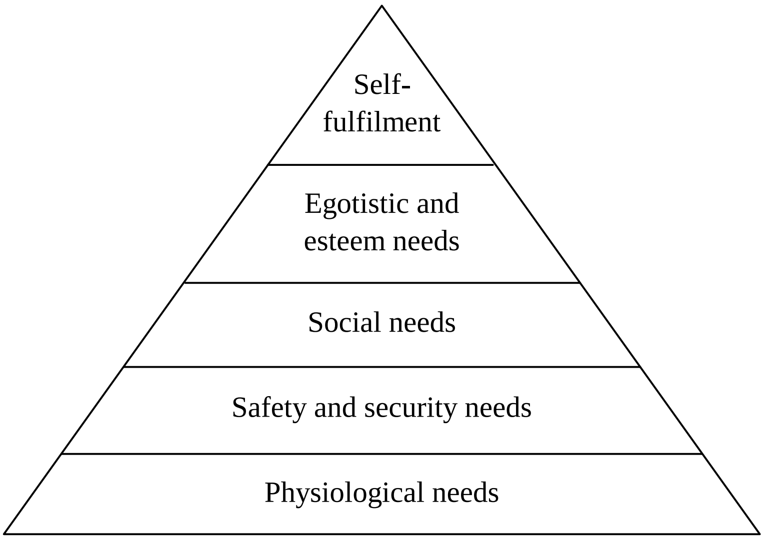

Figure 12.2: Maslow's Hierarchy of Needs

Thus physiological needs are food, warmth, shelter and so on; safety and security would include a job free from the threat of redundancies or change; social needs are the desire to belong to a group of people; egotistic and esteem needs include the attainment of status and respect, whilst the final category, self-fulfilment, is the ultimate state that an individual aspires to.

Once a need is satisfied it no longer motivates an individual as strongly. The achievement of each of the needs is not necessarily chronological; a person may attempt to achieve his or her self-fulfilment without having achieved any social needs. However, the research suggests that people will attempt to achieve those needs at the lower levels of the hierarchy first. High levels of motivation in the workplace will be achieved in instances where job security exists with the potential for self-fulfilment and the satisfaction of egotistic and esteem needs through the attainment of respect and recognition.

(b) McGregor

McGregor's "Theory X" and "Theory Y" is another of the better known motivational theories. Put forward in his book "*The Human Side of Enterprise*" (1961), Theory X states that a certain type of worker does not like work, avoids it whenever possible and needs to be coerced or threatened in order to perform. Theory Y, on the other hand, is based on the belief that workers will attempt to achieve objectives to which they feel dedicated and will learn to look for responsibility themselves given that the correct environmental conditions apply.

Under Theory X, therefore, the use of threats or rewards to get things done is very common, whereas those managers who believe Theory Y allow subordinates to achieve their personal objectives with much more of a laissez-faire approach from management.

In the latter case, people do not necessarily like to work, but they develop their approach to it in accordance with their own personal experience of it.

(c) Herzberg

In "*Work and the Nature of Man*" (1966), Herzberg put forward the idea that job satisfaction and dissatisfaction are not direct opposites to each other. Job satisfaction arises out of actual attainment of the task being done, and dissatisfaction from the environment in some way. Therefore, removal of the causes of dissatisfaction would not automatically lead to job satisfaction; the work itself has to present opportunities to the worker so that satisfaction can be obtained.

Herzberg considered that "extrinsic motivators" attracted people to work, and if retained, would persuade people to remain. They would include remuneration, working hours and so on. "Intrinsic motivators", on the other hand, relate to work content and include challenging and interesting tasks and the opportunities for development and achievement.

Budgetary control would therefore play an important part in the achievement of the "intrinsic motivators" by providing the mechanism by which they could be attained.

Need for Employees to be Committed

However comprehensive our system of budgetary control may be, and however much thought has been given to the preparation of such a system, we must never forget that it has to be operated by human beings, and to ensure success it is essential for each employee to be highly committed to the project. The budget in itself will not change a poor sales person into a good one – it is only one piece of equipment available to management.

Let us consider some of the ways in which the level of motivation may be raised.

- It should be demonstrated to each employee the benefits that he or she can derive as a person from the process. It is unfortunate that many people believe that budgetary control is used by management as yet another stick to beat the employee and that it will be quoted as evidence of his or her failings. We must remove this belief at the earliest possible moment.
- Great encouragement can be given to employees if it is made clear to them that when they show their understanding and use of the system, they are proving their potential for future promotion. They are showing that they appreciate the importance of one of the techniques of management and this is part of the training ground for future top management.
- Many managements are quick to find fault and to conduct most thorough investigations where adverse variances are revealed, but they are most reluctant to pass on words of praise although they may be well deserved. Let us remember that people do respond when they are made to realise that their efforts have been recognised and appreciated.

Problem of Separate Budget Centres in Relation to Staff Motivation

A problem within a large organisation is that there are many separate budget centres. It is very difficult for the budgets of one centre to be related to the budgets of the remaining centres, and although each centre will know its own results, it may be unable to appreciate how these results have contributed to the total business performance. By good communications and a wide distribution of information, we must ensure that there is no attitude of "my individual contribution cannot possibly have any effect on the end results".

Need for Staff Participation

There is a very close link between participation and motivation. When related to budgetary control, staff who have been involved in the preparation of budgets will want to see the project succeed. Where mere imposition of budgets has taken place, there is little chance of great enthusiasm being generated.

We must remind ourselves that the general factors affecting human effort at work can also be related to motivation in the operation of budgets and standards. Each of the following has an influence:

- General attitude of individuals to their work
- Interrelationships of people
- Effects of environmental conditions
- Attitude of management to other employees
- Changing social attitudes.

Identifying Where Motivation is Lacking

Having identified motivation and looked at ways of enhancing it, it is useful to look at evidence which indicates that demotivation exists:

- Budgets may have been set by a department with neither thought nor care that they should be co-ordinated with those of other departments.
- Budgetary 'slack' may be built into budgets, especially where the manager concerned has a fear of failure and/or the budget is used by senior management as a pressure device.
- Managers may do just enough to achieve their budgeting targets without making much attempt to exceed them.
- There may be a failure to control by management, shown by a willingness to accept work of a substandard nature from subordinates.
- As well as the lack of co-ordination mentioned earlier, there is also the possibility of a lack of co-operation between managers. This would become especially important in those cases where each manager's department relies on the other, for instance where the output of one forms the input of the other.
- A sudden rush to spend up to the budget limit near the end of the budgeting period because it is felt that expenditure targets will be reduced in the following period.

Reasons for Absence of Motivation

- Absence of consultation between those responsible for implementing and those responsible for setting the budgets. (The question of participation in the budgeting process will be examined again shortly.)
- There may be a lack of flexibility on the part of senior management in the setting of budgeting targets, the argument from those on whom the budgets are imposed being that less rigidity is needed when taking operational decisions.

- Budgets may be seen as pressure devices; their only reason for existence being to find fault rather than identify where individuals and departments are performing correctly. This again refers to the attitude which is often adopted by those managers who wish merely to avoid failure by attempting to get targets set at a relatively easy level.
- There could be a lack of understanding on the part of those concerned, especially in how their individual contribution relates to the organisation's objectives.
- The control information being produced may be suspect. This could be because the managers concerned have not been properly trained to understand it, but it might also be because the reports have been proven to contain errors in the past. Once this happens it is very difficult to make people believe reports are correct. In addition, if there is too much information too often it will lose its effectiveness and the individual managers will, therefore, be unable to recognise if they are outside their budget or performing well. Allied to this latter point are the problems that may occur if control information is produced a long time after the period to which it relates; again it may be largely ignored, and with good reason.

Participation and Aspiration Levels

When we refer to budgetary participation, we must be careful not to produce this glibly as a stock answer to a question on how to improve the objectiveness of the budget as a tool for control and performance measurement. The level of participation should be **carefully controlled**; if negotiation between a manager and his or her superiors is part of the process it will inevitably expand the amount of time required for its completion. Care must be taken, therefore, to allow sufficient time rather than overrun into the period in question and be forced to impose budgetary targets from the top.

This also applies to the number of people who are involved; the more people, the longer it will take and so from this point of view you can have too much of a good thing. Most of the time allocated for deciding upon the budgets will be spent at a low level in the organisation with everyone arguing for their own slice of the action.

Remember, too, that directors/senior management have the final say as to what the budgets will be. If, even after participation, they are arbitrarily imposed it will be seen as positively demotivating rather than the opposite.

(a) Aspiration Levels

Much research work has been conducted by behavioural theorists into the **target levels** set within a budget, both by the individuals responsible for attaining them and those responsible for setting them: these are known as **'aspiration levels'**. This research has generally shown that targets that are set too high do not act as motivators at all. They are considered unattainable and thus no effort is expended on attempting to achieve them and a worse than usual performance results. In a similar way, targets which are too easy can also act as demotivators; the ease with which targets are reached being no spur to improving performance.

The optimum target is the most difficult that will be accepted and here the element of participation is most important. It is, of course, extremely difficult to ascertain this optimum position, because every situation differs. It is a matter of close collaboration and negotiation for the parties concerned.

Some individuals, for instance, will have aspiration levels far in excess of their colleagues; the mere fact that extremely difficult targets are being set is, for them, a spur to greater achievement. In this scenario, however, failure by too great a margin is likely to be counter-productive in the same way as excessive targets normally are.

(b) Does Participation Help?

It can be recognised from the research that has been undertaken by the likes of **Stedry** and **Hofstede** that participation does have an effect on helping to improve performance. Straight imposition of a budget without regard to the views of those responsible for achieving it is likely to result in little or no effort to do so.

There are also problems which arise, such as how much participation should be allowed and at what stage participation should end and imposition begin. If too much participation is allowed the budgets may not be set properly, and at some stage senior management must impose a budget which will be for the benefit of the organisation as a whole; if it can be set so as to motivate the individual manager and his or her department, however, so much the better.

If aspiration levels can be ascertained, then the target element of the budget becomes much easier to determine. The difficulty is in ascertaining it because, as Stedry has showed, aspiration levels alter with the target itself.

Unfortunately, there is also empirical evidence which suggests that participation does not automatically lead to improved performance. **Argyris** for example, found that some companies practise what he termed "pseudo-participation", i.e., that they profess to allow it when in actual fact such participation is subject to managerial pressure.

Some of the factors which determine if participation is effective are:

- ***Culture of the Organisation***

  Hopwood found that participation was less effective in instances where greater regimentation or automation was in place because there was less chance of actually having an impact on results. The opposite was also true, however, situations of greater innovation being more suitable for participation to take place.

- ***Attitudes of the Individual***

  Some people prefer to have targets imposed on them; they like to please their superiors by having targets which the authorities have set. Others, by contrast, are more independent, and will object to the imposition of budgets.

- ***Experience***

  This refers to the fact that managers may be used to the idea of having targets imposed, and thus, knowing no different, they fail to realise the benefits of having an influence on the budget.

- ***Social***

  The effectiveness of participation will vary from country to country. The culture of Eastern European countries, even in the 1990s, is towards acceptance of authority.

Study Unit 13

Standard Costing

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INTRODUCTION

One of the principal objects of any management accounting system should be to assist in the planning and control of operations. The techniques of budgetary control and standard costing can help management carry out this vital function.

In this and the next two study units, we will be looking at the objectives and methods of standard costing; these will help us understand its purpose, the methods by which standards are set, the procedures for calculating variances, and the interpretation of variances (and their relationship with budgeting).

A. PRINCIPLES OF STANDARD COSTING

Whereas budgetary control is concerned with the **overall plans** of the organisation and assignment of responsibilities for control over revenues and expenditure, standard costing is concerned with the establishment of **detailed performance levels**, together with the related costs and revenues per unit and in total for the planned activities of the organisation.

Budgetary control and standard costing have certain features in common:

- The setting of targets or standards
- The recording of actual results
- The comparison of actual results with standards
- The computation of variances and their analysis, and arranging the appropriate corrective action.

However, you should note that standard costs are used in the **construction of budgets**. The company's standard cost for each product will be updated and recalculated at the appropriate rates relating to the following year. Budgeted sales quantities multiplied by these updated standards provide the cost of sales figures for the budgeted profit and loss account. This approach also allows budgeted standards to be compared with actual performance once this has been calculated. Any corrective action can be taken in respect of standards and/or budgets and in the actual production methodology.

Definitions

The Chartered Institute of Management Accountants (CIMA) uses the following definitions:

- **Standard Costing**

  "A technique which uses standards for costs and revenues for the purpose of control through variance analysis."

- **Standard Cost**

  "A predetermined calculation of how much costs should be, under specified working conditions.

  It is built up from an assessment of the value of cost elements and correlates technical specifications and the quantification of materials, labour and other costs to the prices and/or wage rates expected to apply during the period in which the standard cost is intended to be *used. Its main purposes are to provide bases for control through variance accounting, for the valuation of stock and work in progress and, in some cases, for fixing selling prices."*

We can see from these definitions that standards are compiled **prior** to production taking place, and that they relate to **specific assessments** of physical quantities and cost. They are, in effect, yardsticks against which actual quantities and costs or revenues can be measured. If circumstances or conditions change, then a revision of standards will be required – so the standards in use reflect the current specifications. The standards may also be subject to annual or periodic **updating**.

Types of Standard Cost and System

- **Ideal Standard Costs**

  These are based on **ideal** conditions – i.e. 100% efficiency is expected from workers, machinery and management: it is only in an automatic and very efficiently run factory that ideal standard costs are likely to be achieved.

- **Attainable Standards**

  These are based on **attainable** conditions, and they are more realistic than ideal standard costs. Provided that all the factors of production are made as efficient as possible **before** the standards are set, the standard costs are likely to be of great practical value. They represent, to workers and management, realistic figures, capable of achievement, since they include allowances for normal shrinkage, waste, breakdowns etc. The variances really do mean increased or reduced efficiency.

- **Basic Standard Costs**

  These are a special type of standard cost. The idea is to select a base year, and then set the standards (ideal or attainable **at that time**). The standard costs then remain in force for a number of years without being revised.

  Their principal advantage is that **trends in costs** over a number of years can be seen quite readily. Another advantage is that the **actual value** of stocks is known – and so there is no problem of converting standard costs to actual costs for use in final accounts. This assumes, of course, that it is desirable to use the actual cost of the stocks. There is a tendency to advocate the use of the standard costs for stock valuation and, if this view is taken, there is no disadvantage in using ordinary standard costs.

- **Current Standard Costs**

  These are standard costs which represent **current conditions** – i.e. they are kept up to date. Ideal standards and attainable standards are both current standard costs, which are changed when conditions change.

Application of Standard Costing

Standard costing is applied most successfully to continuous or repetitive operations, where large volumes of a standard product are produced. The application of standard costing principles to job costing systems is more difficult, as products will vary – each one may be unique. As the products themselves are not standardised, the emphasis will be on the machines and operations concerned. Standard feeds and speeds for machines may be developed, as well as output for handwork operations. These standards will then be applied to the specifications for individual products.

The Advantages and Disadvantages of Standard Costing

The advantages of using a standard costing system are as follows:

- Standard costing is a useful basis for budgetary control.
- It can be used as the basis for setting targets to motivate staff.
- Efficiency in the use of resources should be enhanced, providing standards are set with the objective of utilising the most appropriate resources for the job in hand.
- By using various investigative models (which we shall examine later), it is possible to identify the point at which investigation should take place without the need for management constantly to monitor the situation (i.e. management by exception).
- The impetus will exist to ensure that the most efficient use is made of resources.
- Standard costing can be used in control systems to enhance positive variances and tackle negative ones.

The disadvantages are as follows:

- A standard costing system can be time-consuming and expensive to install and operate.
- Responsibility for the cause of variances is not always easy to identify.
- Standards may be viewed as pressure devices by staff.
- Standards are difficult to determine with accuracy.

Types of Variance

The difference between a standard cost (or budgeted cost) and an actual cost is known as a **variance**.

- **Favourable and Adverse Variances**

  Variances may be favourable or adverse. If actual cost exceeds standard or budgeted cost, then the variance is **adverse**. On the other hand, if actual cost is less than standard or budgeted cost, then the variance is **favourable**. (Note here that overhead volume variance is an exception to this general statement.) An adverse variance is often shown in brackets, although the convention is also used of showing F after figures for favourable variances and A for adverse variances.

- **Classification According to Cost Element**

  To make the variances as informative as possible, they are analysed according to each **element of cost** – i.e. material, labour and overhead. A further analysis is then made, under each heading (material, etc.), according to price and quantity etc. We will be discussing further subdivisions of some of these variances later.

B. SETTING STANDARDS

Before manufacturing costs can be predetermined, the following factors must be stated:

- The **volume** of output.
- The relevant, clearly-defined, **conditions of working** (grade of materials, etc.).
- The predetermined **level of efficiency**.

Each element of cost – material, labour and overhead – must be taken in turn, and the standard cost for each product determined. The object must be to ascertain what the costs **should** be, and not what they **will** be.

Before any attempt is made to set the standards, all functions entering into production should be examined and made efficient. It will then be possible to have standard costs which represent true measures of efficiency.

The following have therefore to be predetermined:

- **Standard Quantities**

  Due allowance should be made for normal losses or wastage. Abnormal losses should be **excluded** from the standards, as these are **not** true **standard** costs.

- **Standard Prices or Rates**

  The aim should be to estimate the trend of prices or rates, and then predetermine these, having full regard to expected increases or reductions.

- **Standard Quality or Grade of Materials, Workers or Services**

  Unless the appropriate grade of material or worker is clearly defined when the standards are set, there will be great difficulty in measuring accurately any variance which may arise.

Setting Standard Costs for Direct Materials

The product is analysed into its **detailed material requirements**, and all the materials are listed on a form called a **standard material specification**.

(a) Material Quantities

Determination of material quantities may be accomplished by one of the following methods:

- Referring to past records – e.g. stores records kept when historical costing was adopted.
- Making a model of the product, noting all significant facts when the test runs are carried out.
- Establishing the relationship between the size or weight of the product and the material content, thereby calculating the standard quantity – in the case of screws, for example, the weight of the screws will indicate the metal content, and a standard quantity can then be fixed.

Great care must be exercised in calculating a reasonable allowance to cover **unavoidable material wastage** – owing to cutting, for example.

(b) Material Prices

Standard prices for materials will be set by the purchasing officer and the accountant.

The actual practice adopted can vary from company to company. Some companies set standards based on what is **expected** to be the **average price** ruling during the budget year. This has the effect of over-costing products during the first half of the year, and under-costing them during the second half. These differences are called **variances** (we will cover their calculation in the next study unit).

An alternative approach is to set standard prices based on **actual prices** ruling on the **first day of the new financial year**. This can be completed before the year begins, as suppliers generally notify price increases in advance. As standards are based on actual prices at the beginning of the year, it is necessary to calculate a budget for material price variances which is the company's estimate of the impact **inflation** will have on material prices.

This approach has the advantage that costs are based on actual prices and not on forward estimates which may or may not be accurate. The standard cost represents the actual cost on the first day of the year and can be used with confidence by the marketing team. As the year progresses the actual material prices will be compared with these standard prices and the financial impact on the company calculated. By comparing actual prices with the prices ruling on the first day of the year it is possible to get an accurate assessment of the rate of inflation applicable to material purchases. This information will be compared with the forecast rate of inflation built into the company’s budget, and can be used to assess the need for selling price adjustments or other corrective actions.

(c) Standard Cost

The standard cost is obtained as follows:

Standard quantity × Standard price

This will be done for each type of material, and the totals added together to arrive at the **material standard cost** for the product.

Setting Standard Costs for Direct Labour

An analysis of the **operations required** to manufacture each product will be essential before the standards are set. The correct **grade of worker** for each operation must also be established:

(a) Standard Time for Each Operation

The standard time for each operation will be set by one of the following methods:

- Referring to **past records**, and then adjusting to allow for any changes in conditions.
- Use of **time-studies based on work study**. Each element of an operation is timed, and then a total standard is determined by adding together all the element times and adding on allowances for relaxation, interruption, etc.
- Employment of **synthetic time studies**. This is really a combination of the above methods. Detailed records are built up by the use of the time-studies, and then, from these records, the appropriate elemental times are selected to arrive at the total standard time for any operation which has not been timed.

(b) Standard Wage Rates

As with material prices, the actual practice adopted will vary from company to company. Some companies base their standards on what they expect to be the average rate during the budget year. This means that they have to anticipate wage increases and changes in methods. An alternative approach is to base standard labour costs on the rates and methods applicable on the first day of the financial year, and then forecast variances based on projected wage increases and changes in methods. In this way the standard labour cost for each product represents the actual cost on the first day of the financial year, and provides similar advantages to those which we outlined in the previous section on material prices.

When an incentive method of payment is in operation, setting the standard rate may be relatively simple. For example, for a piece-rate system, the standard rate will be the fixed rate per piece. To avoid having too many wage rates, **average wage rates** may be used.

To summarise, the standard cost for direct labour is:

Standard direct labour hour × Standard direct labour rate

Setting Standard Costs for Overheads

Overhead costs are often the most difficult costs to predetermine.

(a) Preliminary Classification

One of the first steps will be to divide such costs into the following three classes:

- ***Fixed Overhead Costs***

  In this class, the total remains the same irrespective of output. Senior management determines the extent of the fixed costs when formulating policy.

- ***Variable Overhead Costs***

  In this class, the total increases with increased output, and reduces with decreased output, since variable overhead costs are fixed at so much per unit of output or standard hour. For example, the rate may be £0.35 per unit – so, for each additional unit of output to be produced, a further £0.35 must be included in the budget.

- ***Semi-Variable Overhead Costs***

  These are partly fixed and partly variable, and they have to be divided into two parts – thus showing quite clearly the fixed element and the variable element. Once the division has been made, the predetermination of the costs is greatly facilitated. The methods used for separating fixed and variable costs are:

  (i) Regression chart

  (ii) Method of least squares

  (iii) High/low output calculations (thus isolating the overhead total charge – which must be variable).

(b) Determination of Standard Amounts

This may be done by using past records or by using a form of time-study, when work can be divided into work units. For example, it may be possible to estimate the requirements so far as factory cleaners are concerned by fixing a time per square yard of floor for sweeping, washing, or other appropriate task.

The volume of output must be predetermined, so that total variable costs for each type of expense may be predetermined. Particular attention must be paid to the allowances to be made for normal time losses (labour absenteeism, waiting for material, tools, etc.) and also the abnormal time losses owing to a falling-off in the volume of sales. It has been suggested that up to 20%, or even more, may have to be deducted to arrive at a normal operating figure for the short period (known as the **normal capacity to manufacture**), and a **further** 20% or thereabouts deducted to arrive at a figure to cover losses of sales (known as the **normal capacity to produce and sell**). In the latter case, the long-term (say, six or seven years) figures are taken, and then a net yearly average is calculated.

(c) Preparation of Budgets for Factory Overheads

Once the appropriate capacity has been selected and the overhead costs have been classified into fixed or variable, the factory budgets can be prepared. Usually they are prepared departmentally – i.e. a separate budget for each cost centre or department. The hourly absorption rate (machine hour or direct labour hour) is then calculated for each cost centre, and applied on the appropriate standard cost card.

For each volume of output it is possible to have a cost equation, which may take the following form:

$$\text{Total for each class of expenses} = \text{Fixed costs} + \begin{pmatrix}\text{Variable cost}\\ \text{per unit}\end{pmatrix} \times \begin{pmatrix}\text{Units to}\\ \text{be made}\end{pmatrix}$$

The 'units to be made' may be expressed in terms of physical units or in standard hours. The variable cost per unit will have been ascertained from the direct material and labour content, together with variable overheads. Once the variable cost per unit has been calculated, the budget may be built up stage by stage, by entering each expense, and then its amount.

Note at this stage that in practice two types of budget are in use:

- ***Fixed Budget***

  This shows the output and costs for one volume of output only; it thus represents a rigid plan.

- ***Flexible Budget***

  A number of outputs will be shown together with the cost for each type of expense. The fixed costs will be the same for all volumes of output, whereas the variable costs will increase with increases in activity.

Standard Product Costs

Standard product costs are compiled for each product made. This is done by bringing together the standard product materials specifications, the standard operations, the performance standards, and the standard rates. A standard product cost card is given in Figure 13.1.

STANDARD PRODUCT COST			
Product Group: Supershields			***Part No.:*** S12
			Unit: per part
Standard materials specification	**Standard Quantity** *lb*	**Standard Price** £	**Cost** £
E.N. 2.A.1.25" steel	30.0	0.04	1.200
Scrap and swarf	(12.0)	0.004	(0.048)
Total standard materials	18.0		1.1520
Standard operations	**Standard time** *Std hrs*	**Standard m/c hr rate** £	**Cost** £
Press out on 70 ton press	0.01	1.32	0.0132
Turn on capstan	0.04	1.26	0.0504
Braze	0.02	1.22	0.0244
Pack	0.05	1.20	0.0600
Total standard operations			0.1480
Works standard cost			1.3000
Administration overhead: 10% of works standard cost			0.1300
Selling overhead: 3% of works standard cost			0.0390
Total standard cost			1.4690
Standard selling price			1.60
Standard gross margin (on works standard cost): 18.75%			0.30

Figure 3.1: Standard Product Cost Card

Machine Time or Operator Time

So far, the standard rates for labour and overheads have been expressed in terms of operator-time. However, in some circumstances the direct process time is relevant to the machine hour, rather than the labour hour. In these cases, labour and overheads are expressed in terms of a **machine hour rate**.

You can see from the standard cost card in Figure 13.1 that the standard gross margin is £0.30 per part, and that the analysis of the standard gross margin is:

	£
Standard gross margin	0.3000
Administration and selling overhead	0.1690
Standard net profit	0.1310

Computerised Systems

The standard-setting process is enhanced if the company operates a computerised Material Requirements Planning (MRP) system which requires a detailed breakdown of every component and sub-component used in the finished product. These systems are used in the production planning and purchasing functions, and allow companies to 'explode' the forecast production programme into a detailed list of all the metal and components required to manufacture it. This requirement can then be compared with the company's stock positions so that order quantities can be calculated. It is therefore relatively easy to add the standard cost of each component to the computer system, which then enables the computer to calculate the standard material cost of each product. The purchasing system is often linked into MRP systems and as a result it is also possible to update standard costs to actual costs.

Problems with Standard Setting

One of the major shortcomings of a standard costing system is the difficulty in setting standards against which meaningful comparisons can be made of actual results. Here are some of the problems that need to be considered.

(a) Labour Cost Standards

- The departments that have to supply the basic information may not be competent to do so without guidance.
- The operations involved in the carrying out of a job have to be clearly established and this may involve a number of departments.
- The different operations involved may not coincide with the separate cost centres.
- The grades of employees that will be employed at each stage must be known, but these may vary. For example, if trainees or learners are used at any one time, the speed of production will fall and the incidence of spoilage will rise.
- Will the pattern of normal time and overtime used in the production of the standard be followed in practice?
- Work measurement may be required and this can be a lengthy and costly operation.

(b) Direct Material Standards

- It is often difficult to establish a realistic allowance that should be made for defective materials and for spoilage arising during production.
- If standards are set on the basis of test runs, then such runs should be as realistic as possible.
- Different suppliers of the same material can produce significant variances in quality.

- The prices of many raw materials change so frequently that even with the use of price variances, much of the value of the standard can be lost.

(c) Overhead Standards

- It is very difficult to establish what the overhead costs **ought** to be. There is a tendency to use past results and this can lead to very imperfect standards.
- These costs should be related to a normal level of activity. This activity is difficult to define.
- The standards of output must be determined and it is then necessary to determine what overhead costs should be incurred at these levels. These overhead costs will include indirect materials and indirect wages as well as expenses and the exercise can be most complex.

C. SETTING STANDARDS – THE LEARNING CURVE

The CIMA defines the cost experience curve as:

> *"The relationship plotted between cost per unit expressed in constant money terms, and cumulative units produced per unit – usually plotted on a double logarithmic scale."*

This is commonly referred to as the **learning curve**.

As workers become more familiar with repetitive manual tasks, they tend to become more efficient, with a consequent lowering of production time and costs. It has been found that improvement through the learning process conforms to a regular pattern and that labour hours can be predicted with a high degree of accuracy.

The learning curve is represented by the percentage reduction in **cumulative** average hours per unit each time production quantities are doubled. Recorded results show that this percentage improvement is commonly of the order of 1 to 40 per cent. The learning curve is usually denoted by the complement of its number – that is to say a 10 per cent reduction in time would be referred to as a 90 per cent curve.

The features of an 80% learning curve are shown in Table 13.1, from which you can see that the first unit is produced in 100 hours and the second in 60 hours. The total hours for the first two units are 160, giving an average of 80 hours, which is 80% of the time taken for the first unit – an 80% learning curve.

Table 13.1: Learning Curve Data

Units Produced (a)	**Cumulative Units** (b)	**Average Hours Per Unit** (c)	**Total Hours** (d) = (b) × (c)	**Incremental Hours** (e)	**Incremental Hours Per Unit** (f) = (e) ÷ (a)
1	1	100.0	100.0	100.0	100.0
1	2	80.0	160.0	60.0	60.0
2	4	64.0	256.0	96.0	48.0
4	8	51.2	409.6	153.6	38.4
8	16	41.0	656.0	246.4	30.8
16	32	32.8	1,049.6	393.6	24.6

You can see from column (c) that there is a progressive reduction of 80% on each preceding figure. If production quantities were to be increased sufficiently, it would be found that the cumulative average time per unit would tend to level off and become stabilised.

Cost reduction associated with the learning curve can also be predetermined. Using the production times given in Table 3.1, and assuming that direct wages and related overhead costs are £10 per hour, cumulative costs in total and per unit can be calculated as in Table 13.2.

Table 13.2: Cumulative Costs

Units Produced (a)	**Cumulative Units** (b)	**Total Hours** (c)	**Total Cost** (d) = (c) × 10	**Incremental Cost** (e)	**Incremental Cost Per Unit** (f) = (e) ÷ (a)
1	1	100.0	1,000	1,000	1,000
1	2	160.0	1,600	600	600
2	4	256.0	2,560	960	480
4	8	409.6	4,096	1,536	384
8	16	656.0	6,560	2,464	308
16	32	1,049.6	10,496	3,936	246

Learning curve statistics can be particularly useful where quotations for long-term contracts are being prepared, or there is a start-up period in the production of a new product. The estimation of costs may also be important for budget purposes.

Example

XY Limited is planning to introduce a new product which will be subject to a learning curve of 80%. The planned production is as follows:

Period	*Units*
1	1
2	1
3	2
4	4
5	8
6	16

The first unit will require 1,220 hours of production. The direct wage rate will be £3 per hour.

Construct tables to show:

(a) (i) Average hours per unit;

(ii) Total hours; and

(iii) Incremental hours per period.

(b) The direct wages per period and for the whole quantity.

Solution

(a) Production Period

Period	**Units in Period**	**Cumulative Units**	**Average Hours per Unit**	**Total Hours**	**Incremental Hours**
1	1	1	1,220	1,220	1,220
2	1	2	976	1,952	732
3	2	4	781	3,124	1,172
4	4	8	625	5,000	1,876
5	8	16	500	8,000	3,000
6	16	32	400	12,800	4,800
					12,800

(b) Direct Wages

Period	Hours Worked	Direct Wages @ £3 per Hour
1	1,220	3,660
2	732	2,196
3	1,172	3,516
4	1,876	5,628
5	3,000	9,000
6	4,800	14,400
	12,800	£38,400

Where Not to Use the Learning Curve

It must be appreciated that there are certain situations in which the learning curve should not be applied or where it may be ignored when setting labour standards. These situations include the following:

- Where labour turnover is high and the full benefits of the learning process are not realised.
- Where the learning period is very short and workers have previously shown an ability to adapt to new work very rapidly.
- Where morale and motivational factors are involved – either enthusiasm to learn new work and processes, thus reducing the learning period, or where past experience has shown that there are restraints by the workforce on the reduction of labour time.
- Where industries or production processes are subject to rapid technological change and new standards are introduced at frequent intervals.

Further Example

A company is asked to quote for a contract to which an 80% learning curve will apply. The contract calls for an initial order of 200 units followed by a possible second order for 100 units. Relevant standards for the initial order are:

Direct materials:		15 metres at £8.00 per metre
Direct labour:	Dept AR	8 hours at £3.00 per hour
	Dept AS	100 hours at £3.60 per hour
	Dept AT	30 hours at £2.40 per hour
Variable overhead:		25% of direct labour
Fixed overhead:	Dept AR	£5.00 per direct labour hour
	Dept AS	£3.00 per direct labour hour
	Dept AT	£2.00 per direct labour hour

The three departments differ in their work composition. Department AR is highly automated and its output, predominantly machine-controlled, is little influenced by operator efficiency. Output in Departments AS and AT is almost exclusively influenced by operator skills.

Required

Calculate prices per unit for the initial order and the second order, allowing a profit margin of 3% on direct materials cost and 10% on conversion cost.

Note: An 80% learning curve shows the following relationship between volume (x axis) and cumulative average price of elements subject to the learning curve (y axis):

x	*y %*
1.0	100.00
1.1	96.90
1.2	93.30
1.3	91.70
1.4	89.50
1.5	87.60

Solution

The cost per unit of the first order is:

	£	£
Direct materials		120.00
Direct labour: Dept AR *(8 hours @ £3.00)*	24.00	
Dept AS *(100 hours @ £3.60)*	360.00	
Dept AT *(30 hours @ £2.40)*	72.00	
	456.00	
Variable overhead *(@ 25%)*	114.00	570.00
Variable cost		690.00
Fixed overheads: Dept AR *(8 hours @ £5.00)*	40.00	
Dept AS *(100 hours @ £3.00)*	300.00	
Dept AT *(30 hours @ £2.00)*	60.00	400.00
Total cost		1,090.00
Profit:		
3% on direct materials cost		3.60
10% on conversion cost of £970.00		97.00
Selling price per unit		1,190.60

Cost of second order:

(Note that the cumulative production is 300 units and that for Departments AS and AT the learning ratio is 87.60%, this being the ratio for a quantity 1.5 times the initial order.)

		£	£
Direct materials			120.00
Direct labour:	Dept AR *(8 hours @ £3.00)*	24.00	
	Dept AS *(100 hours @ £3.60 × 87.60%)*	315.36	
	Dept AT *(30 hours @ £2.40 × 87.60%)*	63.07	
		402.43	
Variable overhead *(@ 25%)*		100.61	503.04
Variable cost			623.04
Fixed overheads:	Dept AR *(8 hours @ £5.00)*	40.00	
	Dept AS *(100 hours @ £3.00 × 87.60%)*	262.80	
	Dept AT *(30 hours @ £2.00 × 87.60%)*	52.56	355.36
Total cost			978.40
Profit:			
3% on direct materials cost			3.60
10% on conversion cost of £858.40			85.84
Selling price per unit			1,067.84

Note the change in fixed overhead absorption because of the reduction in direct labour hours.

Learning Curve – Further Considerations

- Obtaining data to assess the impact of the learning curve can be very difficult.
- There is a limit to the number of times the learning curve will apply; eventually it will become impossible to carry out the tasks any more efficiently.
- Not all industries and processes lend themselves to learning curve phenomena.
- The workforce must be sufficiently motivated in order to achieve constant reductions in the amount of time the work takes to complete. This could involve the payment of productivity bonuses, which could in turn lead to problems if the workforce feels that these bonuses are under threat due to the reduction in the time taken. It is therefore better for such bonuses to be unit, rather than time, related.
- The learning curve presumes that working conditions remain relatively stable in terms of technology and labour turnover. If, for instance, the workforce is expanded significantly then the learning curve may be adversely affected as the new employees settle in.

- If it is considered that the learning curve is present, care must be taken to ensure that production scheduling is set up accordingly and that functions such as marketing and distribution are informed also.
- Care must be exercised when setting-up standard costs if the learning curve effect is known to be present. Interim standards can be used until the learning curve is no longer causing variations in the time the work takes.

D. THE STANDARD HOUR

Perhaps the most satisfactory way of explaining this expression is to consider the definition put forward in the CIMA Terminology. This defines the standard hour/minute as:

> *"The quantity of work achievable at standard performance, expressed in terms of a standard unit of work in a standard period of time."*

Measure of Output Achieved

From this definition, you can see that a **standard hour refers to a measurement of output**, and **not** to the physical passage of time. If an operative works harder than envisaged by the standards, he or she may produce 1.25 standard hours within the physical time of 60 minutes; and, conversely, if an operative works more slowly than standard he or she may only produce 0.75 standard hours in 60 minutes.

In assessing output, the time passage will be 60 minutes and the number of units produced in that time will be recorded to establish the output of a standard hour. Suppose a factory produces rulers, and in 60 minutes it is observed that an operative can produce 400 rulers, then 1 standard hour's output will be assessed at 400 rulers. Further, suppose that, in the course of an 8-hour day, the output of an operative was 3,600 rulers, on the basis of the agreement the **output** would be assessed at 9 standard hours.

Note: 9 standard hours have been produced in 8 clock hours. This distinction between standard hours and clock hours is vital to the statistics of standard costing.

Example

AB & Co. Ltd produces cars of differing engine capacity, the output being assessed in standard hours as shown below:

Engine Capacity	*Standard Hours Per Unit*
1,000 cc	20
1,500 cc	32
2,000 cc	40
2,600 cc	50

The output statement for a week could then be shown in the following way:

AB & Co. Ltd

Output – Week no. 14

Product	Standard Hours per Unit	No. of Cars Produced	Output in Standard Hours
1,000 cc	20	120	2,400
1,500 cc	32	140	4,480
2,000 cc	40	30	1,200
2,600 cc	50	25	1,250
		Total:	9,330

Obviously, when there are changes in methods of production, output comparisons week by week will not be valid. The figures produced above are not affected by changes in rates of pay or any change in the value of money.

The standard overhead cost is expressed as:

Standard hours × Standard overhead rate

E. MEASURES OF CAPACITY

The CIMA Terminology includes three measures of capacity, which are defined below:

- **Full Capacity**

  "Production volume expressed in standard hours that could be achieved if sales orders, supplies and workforce were available for all installed workplaces."

- **Practical Capacity**

  "Full capacity less an allowance for known unavoidable volume losses."

- **Budgeted Capacity**

  "Standard hours planned for the period, taking into account budgeted sales, supplies and workforce availability."

Level of Activity Ratios

Using the above measures as a starting point, various ratios can be developed to show the level of activity attained, and the **efficiency of production**. The CIMA Terminology refers to three ratios: idle capacity, production volume and efficiency.

You can see that full capacity refers to an ideal situation, where there are no losses of any kind. Practical capacity reflects an attainable level of performance, while budgeted capacity takes into account anticipated conditions in relation to sales, production and labour facilities which will be available.

Let's assume the following data for an accounting period (where full capacity is 11,000 standard hours):

Practical capacity expressed in standard hours	10,000	(A)
Budgeted capacity in standard hours assuming 80% efficiency	8,000	(B)
Standard hours produced	7,000	(C)
Actual hours worked	8,500	(D)

The following ratios can be produced:

(a) Idle Capacity Ratio

$$\frac{(A) - (B)}{(A)} = \frac{10{,}000 - 8{,}000}{10{,}000} = 20 \text{ per cent}$$

Note that practical capacity is used, NOT full capacity.

(b) Production Volume Ratio

$$\frac{(C)}{(B)} = \frac{7{,}000}{8{,}000} = 87.5 \text{ per cent}$$

(c) Efficiency Ratio

$$\frac{(C)}{(D)} = \frac{7{,}000}{8{,}500} = 82 \text{ per cent approx.}$$

Study Unit 14

Standard Costing Basic Variance Analysis

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INTRODUCTION

Having established quantity standards for sales, materials and direct labour with the relevant standard sales and cost values, actual operational results are compared with these standards. The differences between the money values for the actual and standard results are known as variances. These variances are intended as a guide to management, to identify the causes of discrepancies between actual and standard performance, and to provide a basis for investigation, possible corrective action and decision-making.

This study unit consists of basic and more advanced variances: note that you will not be expected to be able to compute them in the examination but you must know how they arise, not least because this is an important element of understanding their cause. This latter element will be considered in more detail in the next study unit.

The variances will be calculated from the point of view of a marginal costing system with reference later to the differences that occur when an absorption costing system is used.

A. PURPOSE OF VARIANCE ANALYSIS

In studying the analysis of variances, you should not only understand the techniques of the calculations but also the meaning and possible causes of variances.

Variances are calculated for:

- Sales
- Direct wages
- Direct materials
- Variable overheads
- Fixed overheads.

In each case the variances are classified according to their nature – whether price, efficiency or volume – each type of variance having its own title. The analysis of variable and fixed overheads will depend upon whether absorption or variable costing methods are used.

Variances Produced

Figures 14.1 and 14.2 show the differences that exist between the two different costing methods when carrying out variance analysis.

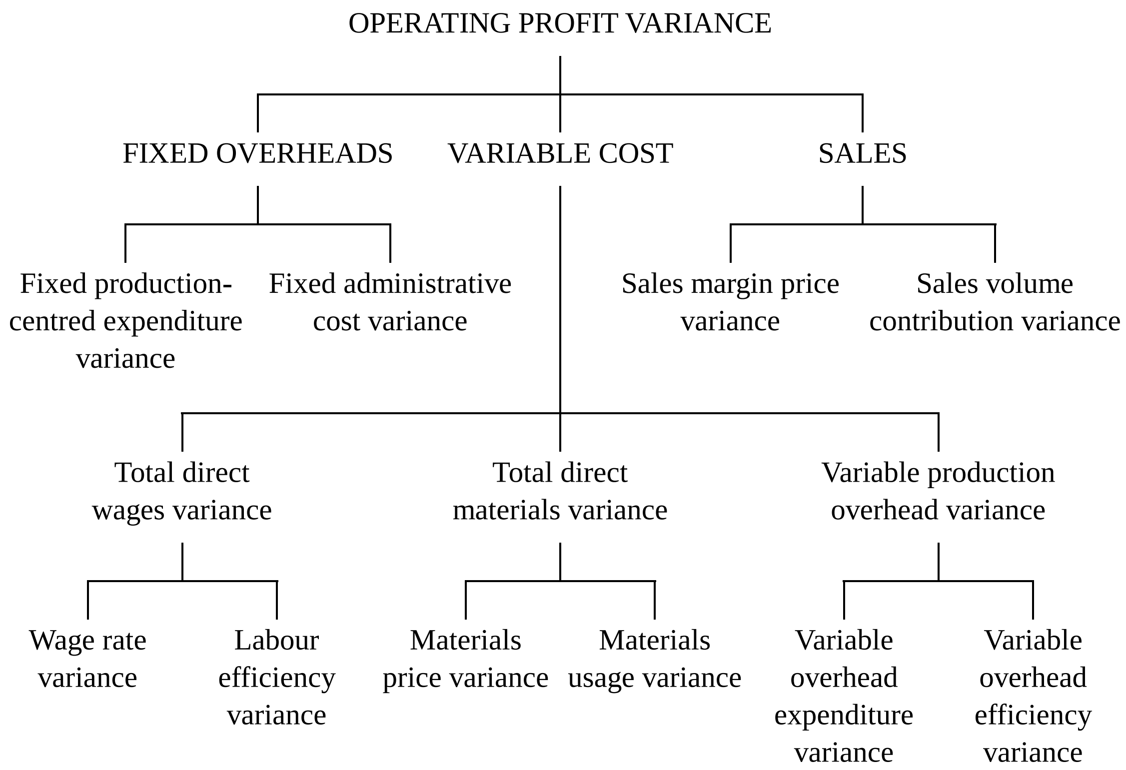

Figure 14.1: Marginal Costing – Variances Produced

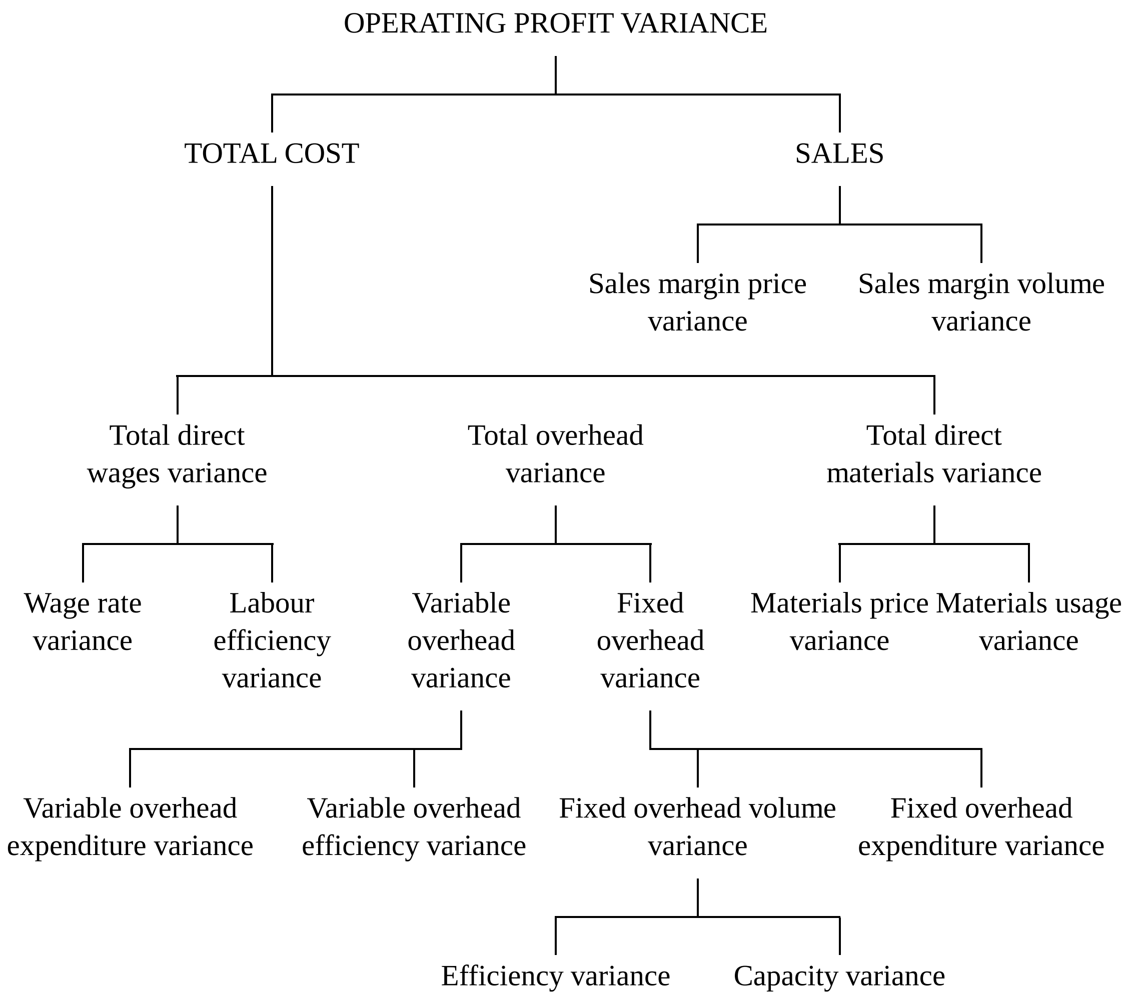

Figure 14.2: Absorption Costing – Variances Produced

As you can see, many of the variances are the same. The differences occur in fixed overheads, which become just an expenditure variance under marginal costing; and sales which is based on contribution with marginal costing as opposed to the standard profit margin under absorption costing.

Variance Analysis, Absorption and Marginal

The method for the calculation of profits under the marginal cost system differs from that of the absorption system. When preparing profits under the marginal cost system, the contribution is calculated by taking the difference between the sales revenue and the variable costs. Fixed costs are then deducted to arrive at profit. Since fixed costs are not considered part of the overall costs for the purposes of calculating closing stock, it follows that the closing stock under the marginal cost system will be lower than that calculated under the absorption system.

When calculating the variances for the sales volume, the marginal system uses the contribution margin whereas the absorption system uses the standard profit margin.

Profit and Loss (Absorption Statement)

	£	£
Sales revenue		45,000
Materials	20,000	
Labour	5,000	
Variable overheads	2,500	
Fixed overheads	15,000	
Total costs		42,500
Profit		£2,500

Although the marginal statement will give the same profit (because there is no opening or closing stock), the layout is a little different:

Profit and Loss (Marginal Statement)

	£	£
Sales revenue		45,000
Materials	20,000	
Labour	5,000	
Variable overheads	2,500	
		27,500
Contribution		17,500
less Fixed overheads		15,000
Profit		£2,500

You will see these differences as we examine variances under each of these different areas. We shall start with the marginal system, and then modify it to explain how variances apply under the absorption system.

B. TYPES OF VARIANCE

We shall now work through the calculation of the basic variances using a hypothetical example. The more advanced subvariances for sales, direct materials and direct labour will be considered later.

Calc-u-like manufactures electronic adding machines and calculators. One specific model, the C12, has a forecast production of 600 units in the forthcoming period and the company has produced a standard costing card as follows:

Unit Costs	**Quantity Used**	**Price per Unit**	
	Kg/Hours	£	£
Materials	10	4	40
Labour	5	2	10
Variable overheads	5	1	5
Total production cost			55
Selling price			90
Contribution			35
Fixed overheads (based on 500 units)			30
Profit			5

The company uses this information to prepare a projected profit and loss account under the absorption system.

Budgeted Profit and Loss

	£	£
Sales revenue		54,000
Materials	24,000	
Labour	6,000	
Variable overheads	3,000	
Total direct cost		33,000
Contribution		21,000
Fixed overheads		15,000
Profit		6,000

The actual results during the year were as follows:

Sales price	£95 per unit
Produced and sold	600 units
Direct material (6,140 kg)	£24,420
Variable overheads	£3,180
Fixed overheads	£15,110
Labour (3,250 hours)	£6,760

Use the above information to prepare a profit and loss account using the marginal costing statement.

Solution

Actual Profit and Loss

	£	£
Sales revenue		57,000
Materials	24,420	
Labour	6,760	
Variable overheads	3,180	
Total direct cost		34,360
Contribution		22,640
Fixed overheads		15,110
Profit		7,530

Now, we must analyse why there is a difference between the budgeted profit £6,000 and the actual profit £7,530.

Material Variances

On the basis of the above information, we should have used 6,000 kg (10 kg × 600) of material and we should have paid £4 per kg. The actual results show that we used 6,140 kg and we paid £24,420. We can break the difference down between a **material usage variance** and a **material price variance**.

Direct material price:	AQ × (SP – AP) or AQ × SP – AQ × AP	£141
Direct material usage:	SP × (SQ – AQ) or SQ × SP – AQ × SP	–£560
Direct material total:		–£419

where: AQ = actual quantity used (6,140)

SQ = quantity that we should have used (6,000)

SP = standard price per unit (£4)

AP = actual price (£24,420/6,140 = £3.977)

AQ × SP = 6,140 × £4 = £24,560 AQ × AP = £24,419

A positive figure indicates a favourable variance, i.e. we spent less than expected.

A negative sign indicates an unfavourable or adverse variance, i.e. we spent more than expected.

In this case the price variance is favourable while the usage variance is unfavourable. A possible reason for this is that we bought cheaper material and as a result there was higher wastage.

Labour Variances

The formulae for labour variances are as follows:

Direct labour rate:	AH × (SR – AR) or AH × SR – AH × AR	–£260
Direct labour efficiency:	SR × (SH – AH) or SH × SR – AH × SR	–£500
Direct labour total:		–£760

where: AH = actual hours worked (3,250)

SH = standard hours that we should have used (600 × 5 = 3,000)

SR = standard rate per hour (£2)

AR = actual rate (£6,760/3,250 = £2.08)

AH × SR = 3,250 × £2 = £6,500 AR × AH = £6,760

In this case both the rate variance and the efficiency variance are unfavourable (the company spent more than expected). Possibly the company had union difficulties whereby workers demanded more pay. The efficiency variance could be caused by demarcation disputes or lack of worker cooperation, etc.

Variable Overheads

The formulae are:

Variable overhead expenditure:	AH × (SVOR – AVOR) or AH × SVOR – AH × AVOR	£72
Variable overhead efficiency:	SVOR × (SH – AH) or SVOR × SH – SVOR × AH	–£250
Variable overhead total:		–£178

where: AH = actual hours worked (3,250)

SH = standard hours that we should have used (600 × 5 = 3,000)

SVOR = standard variable overhead rate per hour (£1)

AVOR = actual variable overhead rate (£3,180/3,250 = £0.978)

AH × SVOR = 3,250 × £1 = £3,250 AVOR × AH = £3,178

The variable overhead expenditure variance is favourable, possibly because there was tight control on expenses. The efficiency variance is unfavourable because more hours were worked than expected.

Fixed Overhead Variance

As explained earlier, with marginal costing systems, fixed overheads consist of an expenditure variance only:

Fixed overhead expenditure variance: (BFO – AFO) –£110

where: BFO = budgeted fixed overheads (£15,000)

AFO = actual fixed overheads (£15,110)

Sales Revenue Variances

The sales revenue variances can be broken down as follows:

Selling volume contribution variance:	SC × (AQ – BQ)	£0
Selling price variance:	AQ × (AP – SP)	£3,000
Total sales variance:		£3,000

where: BQ = budgeted quantity (600)

AQ = actual quantity (600)

SC = standard contribution (£40)

SP = standard price (£90)

AP = actual price (£95)

In this case the budgeted quantity 600 is the quantity which was sold. Therefore, contribution variance is nil. The price variance is positive simply because we sold the products for a higher price than we expected.

Reconciliation Between Budgeted Profit and Actual Profit

Having calculated all the ratios, we can now summarise them as follows:

	£	£
Budgeted profit		6,000
Budgeted fixed production overheads		15,000
Budgeted contribution		21,000
Selling price variance	3,000(F)	
Sales volume variance	–	
		3,000
Actual sales minus the standard variable cost of sales		24,000
Variable cost variances		
Material price	141(F)	
Material usage	560(A)	
Labour rate	260(A)	
Labour efficiency	500(A)	
Variable overhead expenditure	72(F)	
Variable overhead efficiency	250(A)	
		1,357(A)
Actual contribution		22,643
Budgeted fixed production overheads	15,000	
Expenditure variance	110(A)	
Actual fixed production overheads		15,110
Actual profit		7,533

C. MARGINAL VERSUS ABSORPTION COSTING

As we have already noted, the differences in variance analysis under the two costing systems concern the treatment of fixed overheads and sales.

Fixed Overhead Variances

The formulae for fixed overhead variances are as follows:

Fixed overhead exp. variance:	(BFO – AFO)	–£110
Fixed overhead volume variance:	SFOR × (AQ – BQ)	£0
Total fixed overhead variance:		–£110

where: BFO = actual fixed overheads (£15,000)

AFO = actual fixed overheads (£15,110)

SFOR = standard fixed overhead rate per unit (£15,000/600 = £25)

AQ = actual quantity (600)

BQ = budgeted quantity (600)

For the moment, this is relatively straightforward because the actual quantity sold (600) agrees with that budgeted (600). The adverse expenditure variance simply means that more was spent than was budgeted for.

Fixed and Variable Overheads (Alternative Approach)

The fixed and variable overheads can be combined as one under the absorption costing system.

Three ratios replace all the fixed and variable overheads. These are:

- Efficiency variance
- Volume variance
- Overhead expenditure.

In order to calculate these ratios we need the following information.

	Per hour/kg
Standard fixed overhead cost	£5
Standard variable cost	£1
Standard total cost	£6
Budgeted overhead expenditure	£18,000
Actual overhead expenditure	£18,290

We can now calculate the three ratios as follows:

Efficiency variance	–£1,500	STC × (AH – SH)
Volume variance	£1,250	SFO × (AH – SH)
Overhead expenditure	–£40	(SO – AO)
Overhead total variance	–£290	

where :AO = actual overheads (£18,290)

STC = standard total cost per hour (£6)

AH = actual hours worked (3,250)

SH = standard hours that we should have used (600 × 5 = 3,000)

SFO = standard fixed overhead per hour (£5)

SO = standard overheads
i.e. Standard fixed cost + (Standard variable cost × Actual hours)
= £15,000 + (£1 × 3,250) = £18,250

The efficiency variance is unfavourable because the company took more hours to produce 600 goods than was previously budgeted. Nevertheless, the volume variance is favourable; this simply means that there was a greater number of hours worked, so the fixed cost per hour was below standard. The overhead expenditure variance (which is unfavourable) simply means that more was spent than was budgeted for.

Sales Revenue Variances

The sales revenue variances can be broken down as follows:

Sales volume profit variance:	SPR × (AQ – BQ)	£0
Selling price variance:	AQ × (AP – SP)	£3,000
Total sales variance:		£3,000

where: BQ = budgeted quantity (600)

AQ = actual quantity (600)

SPR = standard profit (£5)

SP = standard price (£90)

AP = actual price (£95)

In this case, the budgeted quantity 600 is the quantity which was sold. Therefore, volume variance is nil. The price variance is positive simply because we sold the products for a higher price than we expected.

Idle Labour and Idle Machine Time

If a supplier makes a late delivery then both employees and machines will incur idle time. Separate variances are often calculated so that the management accountant can see how much an unsatisfactory supplier is costing the company. Idle variances can also arise because a machine breaks down, in which case the variances can reveal how much an idle machine is really costing the company. The formula for idle labour variances is:

Standard labour rate per hour × Number of idle hours

and for machines:

Standard machine rate per hour × Number of idle hours

Example

A company produces 600 products each of which requires 5 hours of labour. The standard rate per hour is £2. Actual results were:

Total hours paid	3,300 = £6,930
Total hours worked	3,200

The appropriate variances are:

Direct labour rate:	–£320	AH × (SR – AR)
Direct labour efficiency	–£400	SR × (SH – AH)
Idle capacity variance:	–£200	SR × Idle Hours
Direct labour total:	–£920	

where: AH = actual hours worked (as opposed to paid) (3,200)

SR = standard rate (£2)

AR = actual rate (£6,930/3,300 = £2.10)

SH = standard hours (600 × 5 = 3,000)

Idle Hours = 100

D. MIX AND YIELD VARIANCES

For the purpose of providing more informative analyses for the management, it may be necessary to subdivide some variances into subvariances, to show more clearly the causes and to provide better guidelines for management action. These subvariances can take many forms, and they can be developed according to the circumstances and the particular requirements of managers. Two typical situations are:

- Subdivision of the materials usage into mix and yield variances.
- Division of the sales volume variance into mix and volume subvariances.

Materials Price, Mix and Yield Variances

In process industries it is common for two or more materials to be mixed together to produce a new material. There will be a standard specification for the proportion of each material to be used – a **standard mix** or mixture – which will also specify the allowance for normal wastage from a given input of material. This specification will usually be a standard batch of mixture, according to the normal quantity of input, to produce a given volume of output. This type of operation can lead to variances arising from variations in the mix of materials or the amount of wastage incurred, and the yield obtained from a given input. The material usage variances can therefore be analysed to show the causes arising from these two factors. The example that follows indicates the detailed calculations required to arrive at mix and yield variances. As mentioned earlier, you will not need to undertake the calculations in the examination but you should be aware of them.

Example

A company mixes three chemicals together to produce a new material for further processing. The standard specification is:

Input per batch (1,000 kg)

Material	**Quantity**	**Price per kg**
	kg	£
A	500	1.00
B	300	3.00
C	200	5.00

The standard output per batch is 900 kg.

During an accounting period in which five batches of the mix were processed, the following results were recorded:

Input	**Quantity**	**Price per kg**
	kg	£
A	2,400	1.20
B	1,700	2.80
C	900	5.20
	5,000	

Output for the period: 4,320 kg

There are three variances: price, mix and yield. The price variance is already familiar.

The mix variance represents the gain or loss arising from departures from the standard percentages or proportions in which materials are mixed.

The yield variance represents the gain or loss arising from greater or smaller wastage than that specified in the standard.

The steps in the analysis are:

(a) Calculate the actual cost of input.

(b) Calculate the standard cost of the actual input.

(c) Restate the total input quantity in the standard proportions specified.

(d) Calculate the standard input required for the actual output, and multiply by the standard cost to give the standard cost of the actual output.

The calculations are as follows:

	(a)			(b)			(c)			(d)		
	AQ	AP	AQ × AP	AQ	SP	AQ × SP	AQ_{SM}	SP	AQ_{SM} × SP	SQ_{AO}	SP	SQ_{AO} × SP
	kg	£	£	kg	£	£	kg	£	£	kg	£	£
A	2,400	1.20	2,880	2,400	1.00	2,400	2,500	1.00	2,500	2,400	1.00	2,400
B	1,700	2.80	4,760	1,700	3.00	5,100	1,500	3.00	4,500	1,440	3.00	4,320
C	900	5.20	4,680	900	5.00	4,500	1,000	5.00	5,000	960	5.00	4,800
	5,000		£12,320	5,000		£12,000	5,000		£12,000	4,800 *		£11,520
			(A)			(B)			(C)			(D)

(A) = Actual quantity × Actual price (AQ × AP)
(B) = Actual quantity × Standard price (AQ × SP)
(C) = Actual quantity in standard mix × Standard price (AQ_{SM} × SP)
(D) = Standard quantity for actual output × Standard price (SQ_{AO} × SP)

*i.e. output was 4,320 kg. Normally 900 kg output arises from 1,000 kg input so required input is:

$$\frac{4,320}{900} \times 1,000 = 4,800 \text{ kg}$$

The variances are:

(A) – (B)	materials price variance:			
	£12,320 – £12,000 = £(320) (adverse)	A	£480	(Adv)
		B	£340	(Fav)
		C	£180	(Adv)
(B) – (C)	materials mix variance:			
	£12,000 – £12,000 = NIL	A	£100	(Fav)
		B	£600	(Adv)
		C	£500	(Fav)
(C) – (D)	materials yield variance:			
	£12,000 – £11,520 = £(480) (adverse)	A	£100	(Adv)
		B	£180	(Adv)
		C	£200	(Adv)

Summary

	£	£
Actual cost		12,320
Materials price variance	(320) A	
Materials mix variance	0	
Materials yield variance	(480) A	
Net variance		(800) A
Standard cost of actual output		£11,520

Sales Variances

In the same way as the materials usage mix can be subdivided, so the sales volume variance can be further analysed into mix and volume variances, where more than one product is sold. These additional variances show the gains or losses arising from a change in the **composition of sales**. Different products are likely to have different profit margins – therefore, although gross sales figures may be above budget levels, the profitability of sales may not be as high as budgeted if more units are sold of a less profitable product.

Example

Out of Style Ltd has the following budgeted and actual sales for an accounting period:

Budget

Product	**Units**	**Selling Price per Unit** £	**Standard Cost per Unit** £	**Standard Profit per Unit** £
A	5,000	10.00	8.00	2.00
B	2,000	30.00	20.00	10.00
C	3,000	15.00	6.00	9.00
	10,000			

Actual

Product	**Units**	**Selling Price per Unit** £	**Standard Cost per Unit** £	**Standard Profit per Unit** £
A	5,000	11.00	8.00	3.00
B	3,000	28.00	20.00	8.00
C	2,000	13.00	6.00	7.00
	11,000			

Variance Analysis

	AQ	AP	AQ × AP	AQ	SP	AQ × SP	AQ_{SM}	SP	AQ_{SM} × SP	BQ	SP	BQ × SP
		£	£		£	£		£	£		£	£
A	6,000	3.00	18,000	6,000	2.00	12,000	5,500	2.00	11,000	5,000	2.00	10,000
B	3,000	8.00	24,000	3,000	10.00	30,000	2,200	10.00	22,000	2,000	10.00	20,000
C	2,000	7.00	14,000	2,000	9.00	18,000	3,300	9.00	29,700	3,000	9.00	27,000
	11,000		£56,000	11,000		£60,000	11,000		£62,700	10,000		£57,000
			(a)			(b)			(c)			(d)

(a) AQ × AP = Actual quantity × Actual profit margin
(b) AQ × SP = Actual quantity × Standard profit margin
(c) AQ_{SM} × SP = Actual quantity in standard proportion × Standard profit margin
(d) BQ × SP = Budgeted quantity × Standard profit margin

Analysis of variances

- Sales Price Margin Variance

  (a) – (b) = £56,000 – £60,000 = (£4,000) (adverse)

- Sales Mix Margin Variance

  (b) – (c) = £60,000 – £62,700 = (£2,700) (adverse)

- Sales Volume Margin Variance

  (c) – (d) = £62,700 – £57,000 = £5,700 (favourable)

Summary

	£		£	
Actual profit			56,000	
Sales price margin variance	(4,000)	A		
Sales mix margin variance	(2,700)	A		
Sales volume margin variance	5,700	F		
Net adverse variance			(1,000)	A
Budgeted profit			£57,000	

Study Unit 15

Advanced Variance Analysis and Investigation

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INTRODUCTION

In the last study unit we introduced the concept of basic variance analysis and outlined its importance to management. The most crucial element of variance analysis, however, is not its calculation but the determination of the reasons for its occurrence.

This study unit will consider various methods of investigation, both statistically and graphically, and examine the main causes of variances. We begin, however, by looking at a different method of analysis known as planning and operational variances.

A. PLANNING AND OPERATIONAL VARIANCES

Having studied variances in the previous study unit, you may conclude that because of their complexity they are not used very much in practice. To some extent this is true. However, a new system of **planning and operational variances** was devised with the intention of making variances easier to understand and, more importantly, easier to calculate. The major benefit of planning and operational variances is that they allow for the fact that the original standard or plan was unrealistic to begin with. In this section you will learn how planning and operational variances are calculated and used as part of the decision-making process.

Ex Ante and Ex Post

Often it is necessary to revise budgets simply because the original standards or targets were, for whatever reason, unrealistic to begin with. The original budget is often referred to as the **ex ante budget**, whereas the revised budget is **ex post**.

Example 1

A company's cost structure is as follows:

Sales price	£150	per unit
Variable costs	£80	per unit
Contribution	£70	per unit
Fixed costs	£16,000	

The company planned to produce 500 units in a particular five-day period. However, as a result of a strike, production for one day was lost, so the company only worked for four out of the five days.

Show the planning and operational variances.

(**Note**: The **planning variance** is the difference between the ex post budget and the ex ante budget. The **operational variance** is the difference between the ex post budget and the actual result.)

Solution

	Original Budget	Revised Budget	Actual Budget
Units produced	500	400	410
	£	£	£
Sales revenue	75,000	60,000	61,500
Variable costs	–40,000	–32,000	–32,800
Contribution	35,000	28,000	28,700
less Fixed costs	–16,000	–16,000	–16,000
Profit	£19,000	£12,000	£12,700

The **planning variance** is the difference between the original budget contribution (£35,000) and the revised budget contribution (£28,000) which is £7,000 (unfavourable).

The **operational variance** is the difference between the revised contribution (£28,000) and the actual contribution (£28,700) which is £700 (favourable). We can now prepare a reconciliation statement as follows:

Original profit	£19,000
Planning variance	–£7,000
Operational variance	£700
Actual profit	£12,700

Example 2

A company operates four machines, each of which produces Dictaphones. In a particular period, there are 5,200 machine hours available. Each Dictaphone requires 4 hours' production time. The selling price of each Dictaphone is £30 and the variable costs are £14. Fixed costs are £9,000.

Calculate the operating and planning variances if actual production details were as follows:

	Actual Result
Units produced	700
Sales revenue	£21,000
Variable costs	£9,800
Fixed costs	£9,000

Note: During the period one of the machines broke down. The company therefore operated using only three machines.

Solution

If the managers had been aware of the machine breakdown in advance they would have prepared a realistic budget. They anticipated producing 1,300 Dictaphones (5,200/4). However, as a result of the machine breakdown the maximum they could produce was (5,200 – 1,300)/4 = 975. Therefore the **planning variance** represents 325 × contribution (£16) = £5,200.

You can see this from the following table:

	Original Budget	**Revised Budget**	**Actual Budget**
Units produced	1,300	975	700
	£	£	£
Sales revenue	39,000	29,250	21,000
Variable costs	–18,200	–13,650	–9,800
Contribution	20,800	15,600	11,200
less Fixed costs	–9,000	–9,000	–9,000
Profit	£11,800	£6,600	£2,200

The **operational variance** is simply the difference between the revised contribution (£15,600) and the actual contribution (£11,200) = £4,400.

Planning and Operational Variances in Relation to Contribution

Up to now we have looked at planning and operational variances in relation to sales quantity. However, they could also apply to sales contribution.

Example

A company expects to make 8,000 products which yield a contribution of £20 per unit. However, during the year the company realises that the contribution of £20 was based on costs which have now changed. Accordingly, the correct contribution should have been £16. During the year 8,000 units were sold giving an overall contribution of £136,000. Calculate the planning and operational variances.

Solution

(a) Planning Variance

Original contribution budget: £20 × 8,000	=	£160,000	
Revised contribution budget: £16 × 8,000	=	£128,000	
Difference:	=	£32,000	(adverse variance)

(b) Operational Variance

Revised contribution budget: £16 × 8,000	=	£128,000	
Actual contribution:	=	£136,000	
Difference:	=	£8,000	(favourable)

The original contribution was based on unrealistic costs which were too low, so the planning variance was unfavourable or adverse. However, perhaps owing to very efficient production arrangements, the actual contribution was higher than it should have been, i.e. £136,000 instead of £128,000.

The benefit of breaking down variances in this way is that we can distinguish those expenses which are controllable and those which are not. Planning variances are uncontrollable. There is nothing you can do if unrealistic budgets are set to begin with; however, operational budgets are controllable and can reveal areas of inefficiency which can be corrected.

If a firm experiences a lot of adverse planning variances, then its budget-setting process is unrealistic. Planning variances can therefore highlight areas where unrealistic assumptions were made. The management accountant may find this information useful when preparing future budgets.

The variances in the previous study unit did not distinguish between planning and operational and it was therefore difficult to determine whether adverse variances occurred due to poor planning or inefficiencies. Consequently, the variances produced were of only limited value.

Avoidable and Unavoidable Planning Variances

We can also break down planning variances between those which were **avoidable** and those which were **unavoidable**. Unavoidable variances do not require investigation, but avoidable errors could indicate a weakness in the budget-setting process and therefore merit closer analysis.

If budgets are drafted on an unrealistic basis then overall profitability of the firm could be affected.

Example 1

Peppard Bros employs an accountant to prepare budgets. At the start of the year the following budget was agreed for Product X:

	Units/Hours	**Cost (Units/Hours)**	**Total**
Raw materials	2	£1	£2
Labour	3	£3	£9
			£11

The product required 2 units of raw material and 3 hours of labour. The selling price was £12 per unit and the company expected to make and sell 400 products. During the year, the company realised that the raw material cost was understated; the real cost of raw materials was £1.97 per unit instead of £1 per unit.

Actual production costs were £5,160 (labour costs were £3,600). Assume no fixed costs. Calculate the operational and planning variance. Can we conclude that the accountant was responsible for the loss?

Solution

Generally, if a budget is not realistic this should not affect profits because profits are based on actual results, not budgets. However, sometimes bad budgeting can encourage decisions which subsequently contribute to losses. In this case the original budget was as follows:

Sales revenue	£4,800
Variable costs	–£4,400
Contribution	£400

If the accountant had been aware that the cost of raw materials was £1.97 instead of £1 per unit, the budget would have been as follows:

Sales revenue	£4,800
Variable costs	–£5,176
Contribution	–£376

A negative contribution arises. The accountant would therefore prevent the project from proceeding and thus save the company £376. The overall planning variance is £776 adverse. This planning variance can be broken down between:

- Unavoidable planning variance: £400 (adverse)
- Avoidable planning variance: £376 (adverse)

The avoidable planning variance arises because the management accountant could have avoided the negative contribution if he had used a more realistic price.

The operational variance in this case is positive. The actual result is:

Sales revenue	£4,800
Variable costs	–£5,160
Contribution	–£360

The difference in contribution is £16 favourable.

Example 2

The firm for which you are management accountant produces a wide range of products, one of which contains a material for which there is a substitute and which is budgeted to cost £10 per kg.
5 kg of the material is required to make the product. Subsequent to the completion of the budget, the price of the raw material increases to £10.50 but if the substitute had been used, this would have cost £10.25 per kg.

During the period in question (month 1) 1,980 units were produced with a material cost of £120,000.

Calculate all the necessary operational and planning variances including, for the latter, the extent to which the variance was potentially avoidable.

Solution

(a) Operational Variance

	£	
Actual cost for 1,980 units	120,000	
Revised standard cost (1,980 $\times$ £10.50 $\times$ 5)	103,950	
	16,050	(A)

(b) Planning Variance

(i) Total planning variance using original materials:

	£	
Revised standard cost (1,980 × £10.50 × 5)	103,950	
Original standard cost (1,980 × £10 × 5)	99,000	
	4,950	(A)

(ii) Possible avoidable planning variance (using alternative method):

	£	
Revised standard cost (1,980 × £10.50 × 5)	103,950	
Alternative standard cost (1,980 × £10.25 × 5)	101,475	
Avoidable	2,475	(A)

(iii) Unavoidable:

	£	
Original standard cost (1,980 × £10 × 5)	99,000	
Alt. minimum standard (1,980 × £10.25 × 5)	101,475	
	2,475	(A)

(c) Summary

	£	£	£
Standard material cost (1,980 × £10 × 5)			99,000
Operational variances		16,050 (A)	
Planning variances			
Avoidable	2,475 (A)		
Unavoidable	2,475 (A)		
		4,950 (A)	
Total planning & operational variances			21,000 (A)
Actual cost of 1,980 units			£120,000

Example 3

A company plans to sell 100,000 units at £5 each. Variable cost of each item is £3. Actual results for the first month of its budgeting year show that although it sold as many units as expected (100,000) and variable costs were £3 per unit, the sales price was budgeted far too high and could more reasonably have been set at £3.50. Total sales value for the period was eventually £400,000.

Calculate the appropriate variances.

Solution

Note that we have three different selling prices here: that which we originally expected to achieve, that which was later considered reasonable and, finally, that which **was** achieved.

Total variances are:

	£	
Budgeted contribution (100,000 × (£5 – £3)	200,000	
Actual contribution (£400,000 – (100,000 × £3))	100,000	
Total variance	100,000	(A)

(a) Operational Variance

This is purely related to sales price and is the difference between the revised and actual sales price.

	£	
Actual sales (100,000 × £4)	400,000	
Revised budget (100,000 × £3.50)	350,000	
	50,000	(F)

(b) Planning Variance

This is the difference between that which we originally felt could be achieved and that which the estimates were later revised to.

	£	
Original budget (100,000 × £5)	500,000	
Revised budget (100,000 × £3.50)	350,000	
	150,000	(A)

(c) Summary

	£	
Operational variance	50,000	(F)
Planning variance	150,000	(A)
Total variance	100,000	(A)

Subvariances

Before we leave the subject of planning and operational variances, it is worth examining the subvariances that occur within operational variances, i.e. between price and usage.

In Example 2 on avoidable and unavoidable planning variances, the operational variance was shown to be £16,050 (A).

The pertinent details are now as follows:

Budget production	2,000 units
Budgeted usage	5 kg per unit
Budgeted price per kg	£10
Price revision	£10.50
Actual units	1,980
Actual cost	£120,000
Actual usage	10,400 kg

(Note that on this occasion we shall not be assuming that an alternative material can be used.)

Total operational variance:

	£	
Actual cost	120,000	
Revised standard (1,980 × 5 × £10.50)	103,950	
	16,050	(A)

This total operational variance can be split as follows:

Operational price:

	£	
Actual price of actual units	120,000	
Revised standard of actual (10,400 kg × £10.50)	109,200	
	10,800	(A)

Operational usage:

	kg	
Actual quantity used	10,400	
Should have been (1,980 × 5 kg)	9,900	
	500	(A)
At revised standard price (£10.50)	5,250	(A)

Summary

	£	
Operational price variance	10,800	(A)
Operational usage variance	5,250	(A)
Total operational variance	16,050	(A)

Operating Statements

An operating statement is designed to reconcile the original budgeted contribution with that actually achieved by identifying all the constituent planning and operational variances which have caused the difference.

The following is one particular way in which the information could be provided but the actual format will very much depend on the circumstances of the particular case. It is likely that only a small number of the headings will apply at any one time.

OPERATING STATEMENT FOR ABC LTD
PERIOD 1

Original budgeted contribution		X
Planning variances:		
Sales price	X	
Sales volume	X	
Labour rate	X	
Labour efficiency	X	
Material price	X	
Material usage	X	
Machine expenditure	X	
Machine efficiency	X	
Machine idle time	X	
Total planning variances		X
Contribution before operating variances		X
Operating variances:		
Sales price	X	
Sales volume	X	
Labour rate	X	
Labour efficiency	X	
Material price	X	
Material usage	X	
Machine expenditure	X	
Machine efficiency	X	
Machine idle time	X	
Total operating variances		X
Actual contribution		X

By differentiating between the two different categories of variances it is possible to identify responsibility much more clearly; planning variances for instance are the responsibility of those who set the budgets, whereas operating variances are the responsibility of functional management.

Summary of Planning and Operational Variances

If budgets are based on unrealistic standards then the variances calculated between the budgeted and actual results will have only a limited meaning. By breaking down variances between variances caused by poor standards and variances caused by operational inefficiencies, the information can be more useful for corrective action.

Despite the fact that this form of variance analysis is easy to understand it does have certain pitfalls. First, it is difficult to determine (even with hindsight) what a realistic standard is. There are too many yardsticks to measure against and any opinions in this area are very subjective.

In addition, disputes may arise as to the extent to which variances are avoidable or unavoidable. For instance, if an accountant estimated too low a price for raw materials, was it entirely his or her fault, or was the decision based on the information which was available after exhaustive enquiries?

B. INVESTIGATION OF VARIANCES

We shall now go on to look at the investigation of the variances themselves, particularly in relation to their potential significance.

Preliminary Points to Consider

You must remember that there are negative aspects to variance investigation. Staff subject to the investigation may resent the implication that variances arise because they are operating inefficiently or their workmanship is poor. If a variance investigation is to reap rewards then it must operate within guidelines so that investigation time is spent only on those areas that merit investigation.

In addition, variances should as far as possible be broken down between those which are controllable and those which are not. The use of planning and operational variance analysis helps to achieve this objective. It is also helpful to break down variances between those which are avoidable and those which are not.

If a variance is avoidable then a procedure should be implemented which would correct the system so that avoidable variances do not recur. Poor budgeting can often lead to a loss of profits because it encourages firms to apply resources to areas where the profit is not as high as it should be.

Deciding to Investigate

Even when the above points are taken into consideration, management must recognise that not all variances can be investigated. When deciding whether or not to investigate, the above points may assist. However, there are other factors which should also be considered:

- Variances are **interdependent**. An accountancy firm may incur an adverse wage (or salary) variance by hiring top-class accountants. However, in the long run the fee revenue variance may be favourable because the firm has built up a high reputation.
- Sometimes standards are prepared on an **ideal** basis. This means that the standard is set on the basis that nothing can go wrong. For obvious reasons, such standards are difficult to attain, so a large adverse or negative variance is bound to arise. Investigation of these variances may not prove beneficial.
- Even where a variance is significant, i.e. well above the tolerance level, investigation is only worthwhile provided that the expected benefits (success in money terms multiplied by the probability of success) **exceed the cost of investigation**.

Procedures for Investigation

A proposed **procedure** for investigating variances is as follows:

- Standards should be broken down between those which are ideal and those which are attainable. Variances, for the purposes of investigation, should concentrate on the difference between attainable standards and actual results.
- To prevent management from setting unrealistic standards, staff participation is vital. Those responsible for keeping within budget should have a say in the preparation of the budget. In addition, management should try to learn from past mistakes. If in previous budget periods planning variances were unusually large, then this may indicate that the budget was unrealistic, perhaps because not enough trouble was taken to collect essential information on prices, etc.
- To overcome staff reluctance in budgeting, management and staff should arrange for training on the budget-setting process. If staff are fully aware of the firm's objectives and goals, they can then view budgeting in that context. When setting targets they may therefore try to obtain a figure which best achieves the firm's stated objectives rather than pick on some arbitrary figure.
- It would be helpful if staff were aware of the tolerance limit procedure that would apply when selecting variances for investigation. The statistical model may seem like an accurate measure but because it is hard to understand and implement a more practical solution would be the "rule of thumb" method (see later).
- If staff are to maintain confidence in the budget procedure then accuracy is very important. Costs should be coded correctly so that only those who authorise certain expenses are held accountable for them. This is a basic requirement for responsibility accounting.
- Where corrective action is necessary, it should be taken as soon as possible otherwise the variance may accumulate, causing profits to fall or even losses to emerge. It is helpful if a variance for the current month is calculated and shown alongside a cumulative (year to date) figure. By doing this a trend may be visible.

Trend Analysis

- **Trend**

  It may appear obvious but it is very often overlooked that a variance that occurs in one period may be a one-off or matched by an equal and opposite variance in the period immediately before or after. What is important is that the trend must be examined to determine if it may be a problem, either within the standards or in the operations. For instance, an adverse material usage variance of £50,000 which is matched by a favourable variance of the same amount in the preceding period, is of less significance than an adverse variance of £5,000 per month for the last ten months.

- **Materiality**

  The variance to be investigated must be of a suitable size to be worthwhile. In our previous example, for instance, the variance of £5,000 per month would not be worth investigating if total material usage was £500,000, but probably would be if it was only £50,000.

- **Controllability**

  The ability to control the variance should also be taken into consideration when deciding if any further action should be taken. A rise in the level of VAT, for instance, which adversely affects sales volume, cannot be controlled but higher wage levels due to excessive overtime can be dealt with.

Variance Trend

Following on from our brief outline of the importance of trends within variance analysis it is worth examining numerically the effects of trend over time.

Suppose, for example, that a firm has budgeted for a certain labour rate on a specific job. Figures are compiled for a six month period, at which point they are analysed. The original budget assumes an output of 10,000 units per month, and each unit required two hours of labour at a rate of £7.50 per hour. The total labour cost per month was therefore expected to be £150,000 (10,000 × 2 × £7.50). The following are the actual figures for the six month period:

Period	Units	Hours	Total Cost £	Variance %
1	9,900	19,900	155,000	3.33
2	9,500	19,950	160,000	6.66
3	9,850	20,200	158,000	5.33
4	10,600	21,500	175,000	16.66
5	10,900	21,200	172,000	14.66
6	10,000	20,500	165,000	10.00

The variance % is the difference in absolute terms from the original budget and makes no allowance for variations in volume. As you can see, the volume in the first three months is down and costs are up, but because the variance is quite low in percentage terms, it probably would not be investigated until period 4, by which time volume has picked up but costs have risen still further. We can now go on to calculate labour rate and labour efficiency variances and see how the trend has moved by comparison.

Period	Labour Rate Variance £	Labour Efficiency Variance £	Total £	Variance %
1	5,750 (A)	750 (A)	6,500 (A)	4.33
2	10,375 (A)	7,125 (A)	17,500 (A)	11.66
3	6,500 (A)	3,750 (A)	10,250 (A)	6.83
4	13,750 (A)	2,250 (A)	16,000 (A)	10.66
5	13,000 (A)	4,500 (F)	8,500 (A)	5.66
6	11,250 (A)	3,750 (A)	15,000 (A)	10.00

Just to remind you of the calculation for the labour rate and efficiency variances; those for period 1 are as follows:

		£	
19,900 hours should cost (× £7.50 per hour)		149,250	
Actual cost		155,000	
Variance		5,750	(A)
Labour efficiency	*hours*		
9,900 units should take (× 2 hours per unit)	19,800		
Actual hours taken	19,900		
	100 (A)		
At the standard rate per hour of (£7.50)		750	(A)
Total Variance		6,500	(A)

By looking at the variances it is possible to infer some potential causes which could be investigated further; the labour efficiency variance, for example, rises quite strongly in period 2 which could imply that new labour was taken on which may not have been as familiar with the processes involved as the existing workforce. Thereafter, the efficiency variance falls, which could indicate the existence of a learning curve effect on the part of the new workers.

Similarly, the labour rate variance is strongly adverse in periods 4, 5 and 6, which could indicate, if taken with the increases in volume at the same time, that overtime rates were being paid.

Armed with this information managers can now decide on an appropriate course of action; should they, for instance, employ more workers if the increased output is likely to continue, should more training be provided to the new workers to overcome the adverse efficiency variance when they start? Consideration should also be given to the standards; are they still realistic? There are relatively adverse variances in labour rates, for instance, which do not drop below £5,750 in any month.

The cumulative trend can also be calculated and this would provide an earlier indicator of things going wrong (we shall look at the mechanics of this in more detail under control charts). Numerically, the cumulative variances are as follows:

	Before budget flexing			**After budget flexing**		
Period	**Adverse Variance**	**Cumulative**		**Adverse Variance**	**Cumulative**	
	£	£	%	£	£	%
1	5,000	5,000	3.33	6,500	6,500	4.33
2	10,000	15,000	5.00	17,500	24,000	8.00
3	8,000	23,000	5.11	10,250	34,250	7.61
4	25,000	48,000	8.00	16,000	50,250	8.38
5	22,000	70,000	9.33	8,500	58,750	7.83
6	15,000	85,000	9.44	15,000	73,750	8.19

This shows that, after flexing the budget, the level of variance remains fairly constant at around 8% and the large adverse movement occurs in periods 1 and 2. Without flexing the budget, the period that seems to cause the trouble is number 4. If a cumulative variance of 8% was taken as the point at which an investigation should be made then under the unflexed budget this would not be carried out until period 4 by which time it may be too late to take corrective action. Under the flexed budget, the problem would be identified in period 2, allowing corrective action to be taken that much earlier.

Management Signals

One of the most important purposes of trend analysis is to identify potential problems where an interrelationship exists between different variances.

Examples of these ‘signals’ include the following:

(a) Sales Price and Sales Volume

If demand for a product is inelastic (i.e. not affected unduly by sales price), then there should be no problem as changes in price will correspond with changes in volume. In those instances where demand is elastic, a small change in price will lead to a large change in volume. If a company is attempting to increase its share of the market through higher volume, for instance, it may be possible to identify this from trend analysis. It is likely that the trend for the sales volume variance will be improving while sales price variance may be worsening or have worsened but is now stable.

(b) Labour Rate and Labour Efficiency

We have already examined the link that can exist between these in our previous example. To recap, employment of new members of staff may lead to a lower labour rate and hence a favourable variance, whereas it is likely that, for a short time at least, labour efficiency will suffer an adverse variance. The effects of the learning curve should not be discounted subsequently.

(c) Material Price and Material Usage

Another commonplace relationship exists between the quality of materials used and its effect on price and usage variances. If a company decides to use a lower grade substitute material, for instance, there could be a positive price variance which may be offset by a negative efficiency variance. This is because the lower quality causes more wastage and a higher volume of material is required to produce the same output as previously.

(d) Material Price

There can be many reasons for adverse material price variances which include seasonal variations, general price inflation and scarcity of raw materials.

Uncertainty in Variance Analysis

It may appear from the foregoing that the investigation of variances is quite straightforward and they can usually be attributed to a particular reason. Unfortunately, this is not the case and the following are a few of the areas which can cause uncertainty over the true causes of variances:

(a) Planning

One reason for a variance, of course, may be that the original standards against which the actuals are judged are incorrect. A major price rise imposed by a supplier may have been missed when the original standards were set or a wage rise which occurred early in the budget period may not have been forecast. In addition, if the standards are not regularly updated or there is a long time-scale between updates it is likely that they will quickly become out of date.

(b) Measurement

Difficulties can arise in ascertaining figures with absolute certainty. Sales value and volume are usually no problem if an adequate invoicing system is maintained, but material allocation is much more difficult to identify with complete accuracy. Particular difficulties arise when allocating power for instance.

(c) Model

Any variance analysis is only as good as the model that reports it. Any deficiencies in the working of that model will cause shortcomings in the whole analysis, if, for example, a relationship between variables (such as that discussed earlier) is not built into the model.

(d) Implementation

The people responsible for implementing the system of variance analysis may not be implementing it correctly. This could be caused by a lack of training or a lack of willingness; in the latter case this could be to hide potentially damaging results.

(e) Random Deviations

Figures reported are only ever averages and therefore some level of deviation must be expected. Whether that level of deviation is acceptable or not is another matter and we shall now consider the implications further.

"Significant" Variances

In directing the attention of managers to significant variances, we can ensure that the time they spend on investigation and corrective action is directed to the areas that should yield the most productive results. Sometimes, to decide the interpretation of 'significant' on a percentage basis, e.g. any item that shows a variance of + or – 3% from budget, may not be satisfactory. The expenditure involved in a variance of that size may be insignificant when considering some budget items but it may be very large indeed when other items are involved. It may be a better solution to lay down actual amounts of variance that can be regarded as acceptable, but even this idea may have its drawbacks. An apparently small variance in one department can lead to quite serious effects in other departments. This is where the judgement and experience of managers are important.

Control Charts

When managers are presented with variance reports indicating that there is a need for investigation and explanations, there must be a follow-up to ensure that the necessary action has been taken. This control may be exercised by the financial manager so that at the time the reports are issued, **control charts** are prepared, indicating the areas of deviation, the managers responsible and the time allowed for reporting back. The explanations, when received, can be charted and they will form the basis for subsequent reports to the Board. There should also be provision for the control of the results of departments in later periods so that a judgement can be made on the effectiveness of the corrective action that has been taken.

There are three types of control chart:

(a) Basic Variance Control Chart

This is shown as Figure 15.1. The weekly or monthly variances will be plotted and the chart will show the favourable and adverse variance for each period. This is shown in absolute terms, each period being independent of the others.

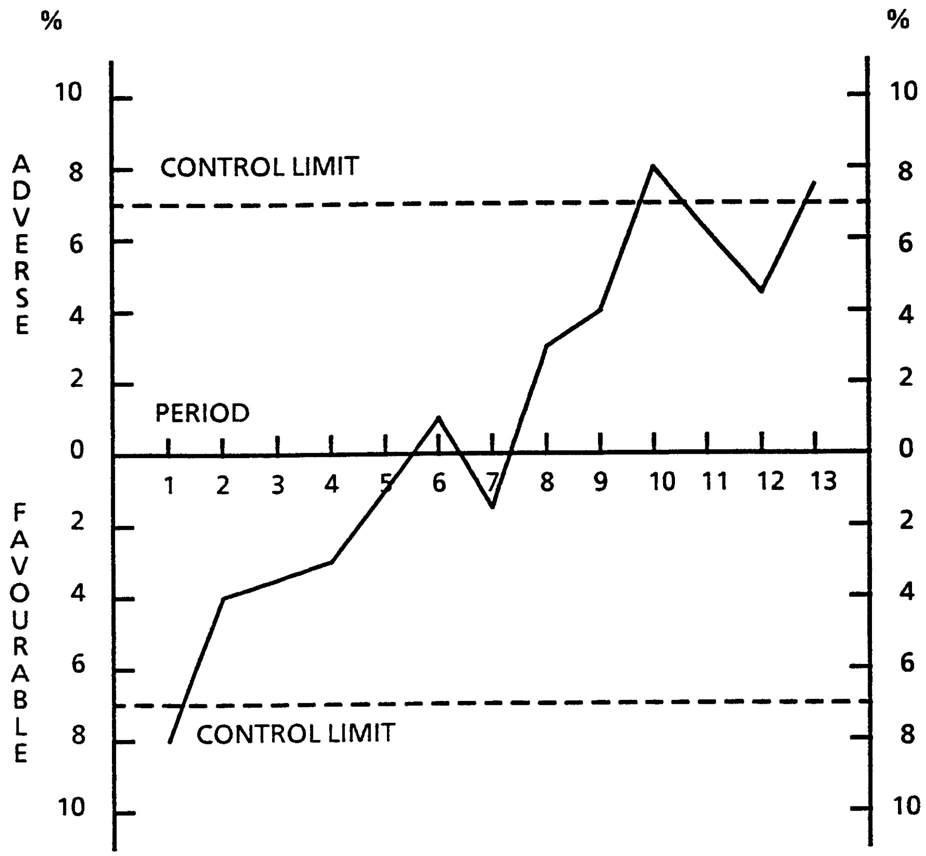

Figure 15.1: Variance Control Chart

(b) Average or Mean Variance Chart

This type of chart (Figure 15.2) is based on statistical significance and uses the mean and standard deviation (see later). The mean would be calculated in the usual way and, for instance, one standard deviation set as the inner warning limit and two as the outer control limit. The use of the inner warning limit serves as an early indication that a process may shortly be out of control. The outer limit represents that situation occurring.

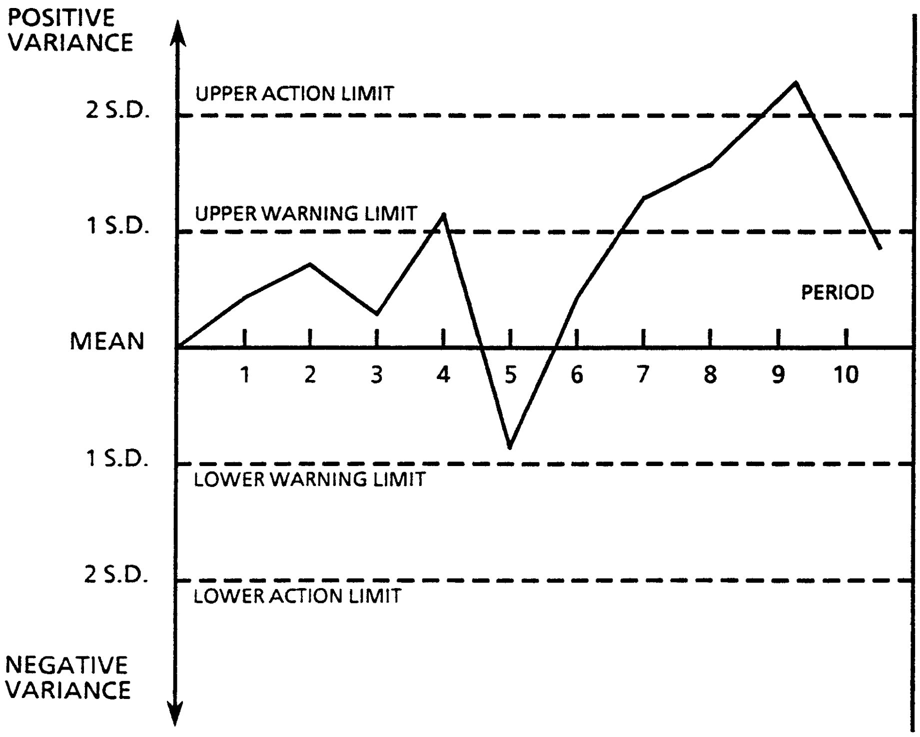

Figure 15.2: Average or Mean Variance Chart

(c) Cumulative Sum (Cusum) Chart

The important element of this chart (Figure 15.3)is that it uses the original data, as the name suggests, in such a way that non-significant variances cancel each other out. Only when variances are significant over a period of time do they become apparent. This is the main difference from the previous examples which took absolute values in each period.

A cusum chart is also helpful for the purpose of investigating variances. The cusum chart recognises that although individual variances may not be significant, when they are accumulated they can be substantial. For instance, if a machine costs more to maintain and repair than was budgeted for, this could indicate that the machine is coming to the end of its useful life. Therefore, as the machine gets older, the maintenance expense will continue to increase and over a period of time the variance may become significant. Obviously, if this variance is picked for investigation, then the accountant can decide if the cost of replacing the machine is less than the cost of repairing or maintaining the old machine.

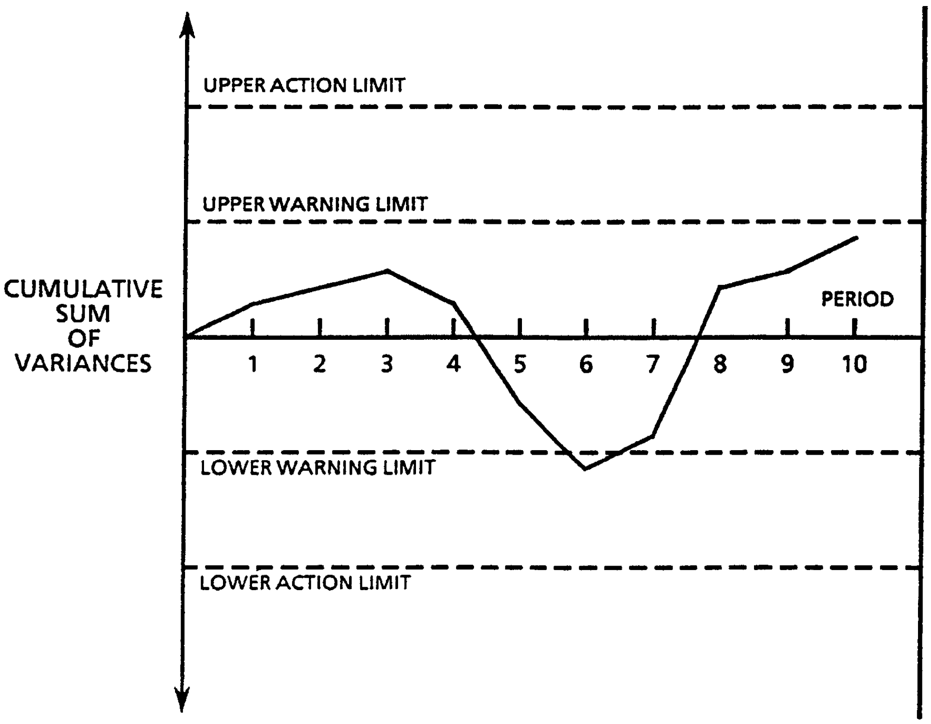

Figure 15.3: Cumulative Sum (Cusum) Chart

Statistical Significance Method of Control

This model is based on the concept of standard deviations and their dispersal around the mean. You should recall from your earlier studies that a normal distribution is evenly distributed either side of the mean and it is therefore possible, using probabilities, to determine the likelihood of a cost falling outside a certain number of standard deviations from the mean.

Once the historical figures are known and the standard deviation has been calculated it is possible to apply significance levels to future data to determine if further investigation is merited. At the 95% significance level, assuming a normal distribution, there is a 95% chance that the data will lie within 1.96 standard deviations of the mean while at the 99% significance level there is a 99% chance that the data will lie within 2.58 standard deviations from the mean.

Thus, if a 95% significance level is set, any errors more than 1.96 standard deviations from the mean should be investigated, while at the 99% significance level, any data more than 2.58 standard deviations from the mean will require further analysis.

As an example, suppose that a firm has determined its average expenditure on maintenance of its machinery is £25,000 per month with a standard deviation of £1,000. If, in a particular month, a variance of £2,250 was identified, should it be investigated further?

The answer depends on the significance level which the firm uses; £2,250 represents 2.25 standard deviations; at 99% significance no further investigation will be called for because this is less than 2.58 standard deviations but at 95% significance it will be investigated because it is more than 1.96 standard deviations from the mean.

A business will have various different types of expenses, some of which will deviate considerably from the mean and some of which will not. Those with a higher standard deviation will be given a higher tolerance limit for investigation purposes.

The advantage of using the statistical model is that predictable expenses (those with a low standard deviation) will merit an investigation, if, for whatever reason, the variance is higher than it should be. Alternatively, those small petty expenses which have a higher standard deviation will escape investigation.

A problem with this model is that standard deviation must be calculated from past data. Past performance may not continue and thus the standard deviation may not be appropriate for future data.

Statistical Decision Theory

Cost/benefit analysis can also be used to determine if a variance should be investigated. The theory basically states that if the cost of investigating the variance exceeds the benefit to be derived therefrom then the investigation should not take place.

The formula for this is as follows:

$$pB \geq I + pC$$

where: p = the probability that the process is out of control

B = the benefit to be derived from corrective action

I = the cost of investigation

C = the cost of corrective action if it is required

Taking a simple example, assume that we have a variance of £10,000, the cost of investigating the variance is £1,000, the cost of corrective action is £3,000, and there is a 50% chance that the variance is controllable and the benefits from corrective action would be £6,000.

Using our formula, the calculation is as follows:

$$0.5(6{,}000) \geq 1{,}000 + 0.5(3{,}000)$$

$$= 3{,}000 - 2{,}500$$

$$= 500$$

As the value is positive it is worth investigating the cause of the variance and taking the necessary corrective action.

The difficulties with this approach are:

- To carry out this type of analysis for every variance on a regular basis would be very time-consuming.
- The estimate of the probability that corrective action will work is highly subjective and therefore prone to error.
- The estimates of the benefits to be derived from corrective action can also be difficult to assess.
- The approach presupposes that the variance will not be repeated and it therefore fails to take account of any future benefits to be derived from corrective action.

Rule of Thumb (or Heuristic) Method

Also known as the **materiality significance model**, this is not as sophisticated or accurate as the above models but it is considered more practical. Here, a firm decides on a percentage (say 10%) and investigates variances which are greater than the given percentage based on standard costs. The great advantage of this model is its simplicity. Unfortunately there are several disadvantages:

- Expenses with a high standard deviation will be continuously investigated regardless of whether they are material or not.
- The setting of a particular limit is rather arbitrary, particularly if applied as a limit across all expenditure. This can be overcome however by varying the percentage for different categories of expenditure.
- If the limit is set too high there is the possibility that a variance that is regularly adverse but does not quite exceed the limit will not be investigated when perhaps it should be.
- The benefits and costs of any investigation are ignored.
- There is no distinction between favourable and unfavourable variances.
- If variances which in the past have been low, say 3% adverse, then rise suddenly, up to 6% adverse (i.e. a doubling of the variance), if the limit is set at 10% no investigation will take place although clearly it should.

C. VARIANCE INTERPRETATION

Having looked at how variances arise, we shall now consider why. Once this is known, corrective action can be taken if the variances are negative, or alternatively favourable variances can be encouraged.

- **Direct Material Price**

  This variance would probably be the responsibility of the Purchasing Department. Where the actual purchase prices are below standard prices, the difference may arise from special purchase terms, discounts, a general reduction in prices or the purchase of lower quality materials.

  Where the purchase prices are above standard, the cause may be a general rise in prices, a change in materials specifications, or the purchase of smaller quantities from more than one supplier, with a loss of discounts or less favourable terms.

- **Direct Materials Usage**

  The material usage variance is primarily the responsibility of the factory foreman or supervisor. It may be caused by faulty machinery, loss or pilferage, excess wastage, lower quality of materials, faulty handling, or changes in inspection or quality standards.

- **Direct Labour Rate**

  The wage rate variance can be caused by changes in wage rates not provided for in the standards, or the use of a different class or grade of labour from that specified in the standards. Unscheduled overtime premiums or shiftwork rates may also account for variations in labour rates. Where wage rates have changed since the standards were prepared, the variance will not be within the control of managers. Where a different grade of labour is used from that specified, the manager may be held responsible and the matter would require further investigation.

- **Direct Labour Efficiency**

  The responsibility for the labour efficiency variance will generally rest with the supervisor or factory foreman. It may arise through the use of a different machine or machines from those specified, machine breakdown, lack of maintenance of plant, the use of defective or substandard materials, the use of different grades of labour from those specified, changes in operating arrangements or inspection standards, or faulty rate-setting. Delays in production can arise from lack of instructions or bad organisation.

- **Variable Overhead Expenditure**

  The variance indicates that the total of the individual items making up the variable cost is below standard cost of those items for the number of hours worked. It will be necessary to examine each item in detail in order to show the causes of the difference. The costs covered under this heading will be the variable elements of indirect wages, indirect materials and indirect expenses. It will also be necessary to establish which managers or executives are responsible for the control of these costs.

- **Variable Overhead Efficiency**

  This follows the same pattern as that for the calculation of direct labour efficiency and, therefore, the same causes will apply.

- Fixed Overhead Expenditure

  As with variable overhead expenditure variances, the individual items must be examined to identify where savings have been made or, in the case of adverse variances, where overspending has occurred. In the case of fixed overheads, it is likely that a number of the items will be outside the control of production managers or supervisory staff.

- **Sales Margin Price**

  This variance, together with the sales volume margin/contribution variance is the responsibility of the Sales Department. The change in selling prices may have resulted from sales at specially discounted prices or from allowances for quantity purchases. The company might operate in an industry in which prices are determined by market leaders, and it may be forced to follow the market trends. The Sales Department must also check that price concessions given by its sales staff are justified, and take care that any major price reductions are authorised by senior staff.

- **Sales Margin Volume/Contribution**

  This variance may be caused by internal factors (through failure to achieve sales targets set in the budget) or sales targets for representatives may have been set too optimistically, and not be attainable in practice. External factors might include a general depression in the industry concerned or the entry of new competitors.

D. INTERDEPENDENCE BETWEEN VARIANCES

We have touched on this subject already. The following are some of the more common areas where variances can be interrelated.

- **Labour Rate and Efficiency**

  An obvious interrelationship between two variances is that of labour rate and labour efficiency. If, for example, less skilled workers are employed, it is likely that they will be paid at a lower rate than the existing skilled employees. The result will be a favourable variance to the standard (assuming that the standards are not adjusted in advance to allow for the dilution in wage rates). However, the new employees, being less skilled, will take time to settle in and benefit from training and the effect of the learning curve. It is likely, therefore, that an adverse variance will occur in labour efficiency terms. (This can occur the opposite way round as well if a more highly skilled team, costing more to employ, improves the rate of labour efficiency but leads to an adverse labour rate variance.) There is also the possibility that materials usage may suffer because a lower efficiency level leads to more wastage.

- **Material Price and Usage**

  Where more expensive materials are purchased, there will usually be an adverse materials price variance as a result. A consequence of this, however, should be that the materials will be of a better quality, which should result in less wastage and therefore a favourable usage variance. There should also be less re-work and so a favourable labour efficiency variance should follow. If cheaper materials are purchased, there may be a favourable price variance, but there may also be greater wastage and therefore an adverse usage variance.

- **Sales Price and Volume**

  Assuming that the usual rates of elasticity of supply and demand apply, an increase in sales price should lead to a reduction in volume. This will mean that there will be a favourable price variance but an adverse volume variance. The reverse will also apply and a reduction in price should lead to increased sales, and therefore there will be an adverse price but a favourable volume variance.

- **Mix and Yield**

  Variations in the mix of materials used can have several outcomes. Using a more expensive mix may lead to a favourable yield variance, but conversely an adverse mix variance will also occur. If a cheaper mix is used, resulting in a favourable mix variance, the yield may be lower giving an adverse variance. Sales volume might also suffer if the output is substandard and difficult to sell. It may be necessary to sell at a discount, which in turn means an adverse sales price variance.

The above are just some of the instances where a variance in one item may be related to a variance elsewhere. Whenever you look at the causes of variances, it is always useful to bear this in mind and consider whether there is any interdependence between them.

Study Unit 16

Management of Working Capital

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A. PRINCIPLES OF WORKING CAPITAL

Working capital is defined as the excess of current assets over current liabilities, i.e:

Working Capital = Current Assets – Current Liabilities

Every business requires **cash** to meet its liabilities and all the constituents of working capital will, in the short term, turn into cash or require cash.

Working Capital Cycle

When a business begins to operate, cash will initially be provided by the proprietor or shareholders. This cash is then used to purchase fixed assets, with part being held to buy stocks of materials and to pay employees' wages. This finances the setting-up of the business to produce goods/services to sell to customers for cash or on credit. Where goods are sold on credit, debtors will be created. When the cash is received from debtors, it is used to purchase further materials, pay wages, etc; and so the process is repeated. The following diagram summarises this cycle:

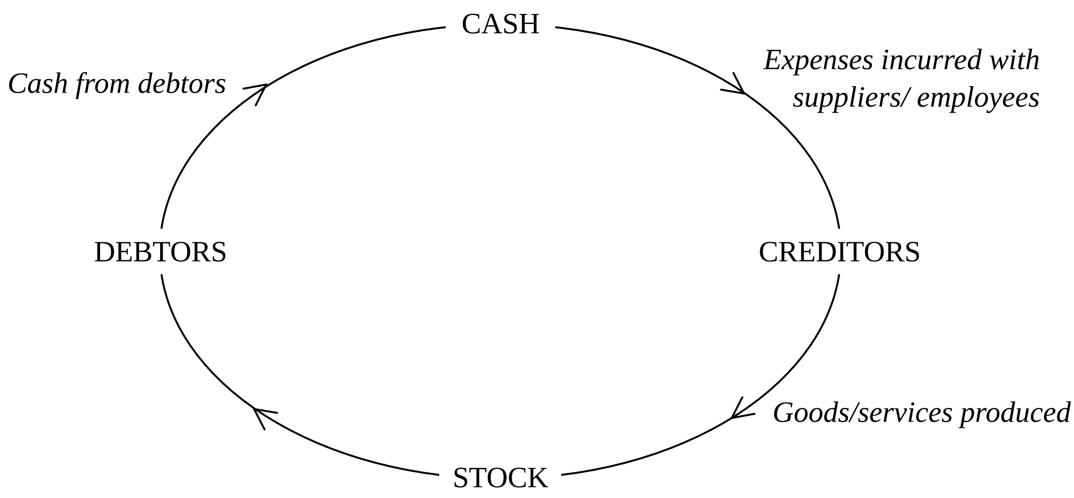

Figure 16.1

The working capital cycle is taking place continually. Cash is continually expended on purchase of stocks and payment of expenses, and is continually received from debtors. Cash should increase overall in a profitable business and the increase will either be retained in the business or withdrawn by the owner(s).

Problems arise when, at any given time in the business cycle, there is insufficient cash to pay creditors, who could have the business placed in liquidation if payment of debts is not received. An alternative would be for the business to borrow to overcome the cash shortage, but this can be costly in terms of interest payments, even if a bank is prepared to grant a loan.

Importance to the Organisation

Working capital requirements can fluctuate because of seasonal business variations, interruption to normal trading conditions, or government influences, e.g. changes in interest or tax rates. Unless the business has sufficient working capital available to cope with these fluctuations, expensive loans become necessary; otherwise insolvency may result. On the other hand, the situation may arise where a business has too much working capital tied up in idle stocks or with large debtors, which could lose interest and therefore reduce profits.

It is therefore extremely important to ensure that there is sufficient working capital at all times, but that it is not excessive. Without adequate working capital a company will fail, no matter how profitable or valuable its assets. This is because, if a company cannot meet its short-term liabilities, suppliers will only supply on a cash-on-delivery basis, legal actions will start and will cause a "snowball" effect, with other suppliers following suit.

Conversely, if working capital is too high, too much money is being locked up in stocks and other current assets. Possibly excessive working capital will have been built up at the expense of fixed assets. If this is the case, efficiency will tend to be reduced, with the inevitable running-down of profits.

The balance sheet layout is ordered so as to show the calculation of working capital (i.e. current assets less current liabilities). Provision of information about working capital is very important to users of balance sheets, e.g. investors and providers of finance such as banks or debenture holders.

A prudent level of current assets to current liabilities is considered to be 2:1 but this depends very much upon the type of business.

Striking the Right Balance

Excess working capital is a wasted resource and therefore the aim of good working capital management should be to reduce working capital to the practical minimum without damaging the business. The areas of concern will be stock, debtors, cash and creditors. The management of these areas is an extremely important function in a business. It is mainly a balancing process between the cost of holding current assets and the risks associated with holding very small or zero amounts of them.

B. MANAGEMENT OF WORKING CAPITAL COMPONENTS

The main objective in stock management is to ensure that the level of stock held is just sufficient to meet customers' requirements efficiently.

Management of Stocks

Control of stock levels begins with calculating the length of time taken to process an item from order through to despatch. A flowchart can aid establishment of the minimum time path. Some safety levels will need to be built in but these should be realistic and not excessive, as too much stock can often end in increased obsolescent stock and decreased efficiency.

A Just-in-Time (JIT) approach can be used, which entails converting raw materials for delivery to the customer in the shortest possible time rather than producing stocks. However, this method needs very careful planning and total supplier reliability. Such reliability is, of course, sometimes unattainable.

Stocks may, in a manufacturing business, include:

- Raw materials
- Work in progress
- Finished goods

The costs involved may be considered under two extremes:

(a) Costs of Holding Stocks

- Financing costs – the cost of producing funds to acquire the stock held
- Storage costs
- Insurance costs
- Cost of losses as a result of theft, damage, etc.
- Obsolescence cost and deterioration costs

These costs can be considerable – estimates suggest they can be between 20% and 100% per annum of the value of the stock held.

(b) Costs of Holding Very Low (or Zero) Stocks

- Cost of loss of customer goodwill if stocks are not available
- Ordering costs – low stock levels are usually associated with higher ordering costs than are bulk purchases
- Cost of production hold-ups owing to insufficient stocks

The organisation will seek the balance which achieves the minimum total cost, and arrive at optimal stock levels.

Management of Debtors

The main objective in the management of debtors (or credit control) is to ensure that all credit sales are paid within the agreed credit period with the minimum administration cost to the company. It is important to maintain a balance so that customers are not alienated in the company's quest for receiving payment on time. Credit terms, credit ratings, settlement discounts and collection procedures need to be drawn up and communicated to the staff involved, from sales representatives to credit controllers.

The terms may differ for different customers, perhaps depending upon the size of the order. In many cases a small number of customers account for a high proportion of sales and therefore a large proportion of debt. In these cases, collecting the cash from the sale should be treated as importantly as the sale itself.

The following procedures may be adopted:

- Assignment of a high-calibre credit manager to deal with these customers.
- The credit manager to discover who is responsible for the payment decisions on behalf of the customer and to deal with him/her personally.
- To liaise with the customer in advance of the due date to ensure that any disputes are resolved and a promise of payment is obtained.

The management of debtors therefore requires identification and balancing of the following costs:

(a) Costs of Allowing Credit

- Financing costs
- Cost of maintaining debtors' accounting records
- Cost of collecting the debts
- Cost of bad debts written off

- Cost of obtaining a credit reference
- Inflation cost – outstanding debts in periods of high inflation will lose value in terms of purchasing power

(b) Costs of Refusing Credit

- Loss of customer goodwill
- Security costs owing to increased cash collection

Again, the organisation will attempt to balance the two categories of costs – although this is not an easy task, as costs are often difficult to quantify. It is normal practice to establish credit limits for individual debtors.

Ratio of Debtors to Sales (or Debtors Turnover Ratio)

It is useful to be able to calculate the number of days' credit allowed to customers and compare this with the general conditions in the same industry. This figure is obtained as follows:

$$\text{Number of days' credit} = \frac{\text{Average debtors}}{\text{Credit sales}} \times 365$$

By taking trade debtors as a fraction of total credit sales, we have an indication of the proportion of sales unpaid at the end of the year. For example, if the figure is one-twelfth then we can more or less assume that no sales made within the last month have been paid for. As this ratio is normally expressed in days, the fraction is multiplied by 365.

Similarly, the ratio of **creditors to purchases** indicates the use of credit that we are making. A rising ratio is not sound.

If the average debtors figure is unavailable, debtors at the year-end can be used.

Management of Cash

Cash at bank and cash in hand should also be carefully monitored, to ensure that sufficient cash is available to meet all needs, but not to have idle cash which could be put to a profitable use.

The preparation of **cash budgets** (see later) aids the control of cash flow by planning ahead for the cash requirements of the business.

Again, two categories of cost need to be balanced:

(a) Costs of Holding Cash

- Loss of interest if cash were invested
- Loss of purchasing power during times of high inflation
- Security and insurance costs

(b) Costs of Not Holding Cash

- Cost of inability to meet bills as they fall due
- Cost of lost opportunities for special-offer purchases
- Cost of borrowing to obtain cash to meet unexpected demands

Once again, the organisation must balance these costs to arrive at an optimal level of cash to hold. The technique of cash budgeting is of great help in cash management.

Management of Creditors

Whereas a business needs to make sure that excessive cash is not tied up in debtors and stock, it also has to attempt to maximise the credit period from suppliers, without incurring the risk of supplies being cut off. Payment dates should therefore be adhered to as far as is practically possible. Suppliers may be more willing to give extended credit terms if the company shows itself to be reliable about repayment dates.

By ensuring that the organisation is always in a position to meet its liabilities, the reputation of the business will grow from the viewpoint of obtaining credit from its suppliers.

C. DANGERS OF OVERTRADING

Overtrading is **expansion with insufficient working capital**. Even a profitable firm can have cash-flow problems when it is trying to expand, despite the fact that no additional capital equipment is required.

Consider a hypothetical firm which is trying to expand:

- In January it takes on extra salesmen – extra cost straight away. They take time to get established, and do not bring in extra orders until March.
- During February the firm has been building up its raw material stocks in anticipation of the extra orders, and its suppliers must be paid in March or April.
- During April additional overtime has to be worked to process the extra orders – more additional cost.
- The goods are completed during May and delivered to the customers, to whom, in accordance with normal practice, the company grants one month's credit.
- Cash is not received until June – the firm has had to finance extra costs for almost six months before it starts to get any benefit.

This clearly shows the difficulties which can arise. It is all very well to launch a business on a plan where sales yield a certain profit figure as per the budgeted profit and loss account, but these plans must be backed up by the available cash. By preparing a cash budget, a business can anticipate such problems and therefore plan for them – for instance by arranging a loan for the crucial period. If it does not make such plans a firm could be forced into liquidation by creditors whom it cannot pay.

D. PREPARATION OF CASH BUDGETS

When drafting cash budgets, essentially all we are doing is writing up bank and cash accounts in advance. All expected income and expenditure will be included.

Income

(a) Sales

Sales revenue will generally form the bulk of the revenue. The sales budget can be broken down by reference not only to when the goods will be sold, but to when the payments are likely to be received.

There will be some **cash sales**, i.e. sales which are paid for immediately, and some **credit sales**. The cash from credit sales will be included in the cash budget after the normal term of credit has elapsed, or after the period of time which has been shown by experience to be normal between the sale and the receipt of cash.

(b) Sundry Revenue Items

These are all sundry items of revenue income which are not covered by sales:

- **Rent of property leased**: the date of receipt and amount will be readily available from leases.
- **Interest on loans etc**: again, reference may be made to agreements and past experience to establish the amounts receivable and the dates on which receipts can be anticipated.
- **Income from investments**: Stock Exchange records will assist in establishing the time of receipt and the expected amount.

(c) Sundry Capital Items

This will include all proceeds of sale of assets and repayments of loans. Information of this type may be obtained from the capital expenditure budget by referring to the new items and assessing the probable income from the sale of the old, and also agreements relating to loans outstanding.

Expenditure

Items of expenditure may include the following, but note that the list is not exhaustive:

- Purchases of goods and services required to be paid in any period. Payment dates will be calculated according to the normal period of credit allowed by suppliers.
- Capital expenditure due to be paid, e.g. for new fixed assets.
- Wages and salaries
- Light, heat, telephone etc.
- Loan repayments
- Miscellaneous expenses, e.g. subscriptions

Note: Depreciation should NOT be included because this is not a CASH expense.

Advantages of Cash Budgets

(a) Credit Rating

By ensuring that the organisation is always in a position to meet its liabilities, the reputation of the business will grow from the viewpoint of obtaining credit from its suppliers.

(b) Finance Planning

Having consciously examined the position with regard to the availability of cash, it may be found that at given points of time there will be either a shortage or surplus of cash.

- ***Cash Shortage***

  An adjustment to expenditure may be made, e.g. purchase of a fixed asset may be delayed, or an approach can be made to the bank to provide short-term credit facilities. Where a bank is shown the full position, supported by a system of budgets, it is more likely that sympathetic treatment will be given to the request.

- ***Cash Surplus***

  Arrangements can be made to invest in the best possible short- or long-term propositions, as appropriate. Full advantage can be taken of any discounts offered by suppliers for prompt payment.

E. CASH OPERATING CYCLE

The length of time it takes between paying for stock through to receipt of cash from debtors is called the cash operating cycle.

Example

A company purchases materials on 1 July. The materials are issued to production on 1 August and payment to the supplier is made on 15 August. The finished goods are sold to customers on 1 September and cash is received from debtors on 1 November.

The stock is taking 2 months to be turned into finished goods (i.e. from 1 July to 1 September). Debtors are taking 2 months to pay (from 1 September to 1 November) and the credit period taken from suppliers is 1½ months (from 1 July to 15 August). The cash operating cycle is therefore:

Stock turnover period	2 months
Debtors turnover period	2 months
Creditors turnover period	(1½ months)
Cash operating cycle	2½ months

The company therefore needs cash available to cover the cash operating cycle of $2\frac{1}{2}$ months.

Control of Cash Operating Cycle

To detect a possible shortage of working capital, a careful watch should be kept on the ratio of current assets to current liabilities. If, year by year, trade creditors are growing faster than trade debtors, stock and bank balances, we may well suspect that, before long, the business will be short of working capital. The speed with which a company collects its debts and turns over its stock are also indications of the working capital's adequacy.

(a) Control of Stocks

Stock turnover rates should be calculated and monitored regularly. Comparison of these rates from one period to another will reveal whether the stock management of the company is deteriorating or improving; and this will be an indicator of the general management standards of the company.

Comparison of stock turnover rates will also reveal any tendency to manufacture for stock. Manufacturing goods to be held in stock is a dangerous practice as it involves the company in expenditure on materials, wages, expenses, etc. but no receipts will be obtained for these items.

(b) Control of Debtors

Debtors turnover rates should also be calculated and monitored regularly. Any increase in the length of time debtors take to pay could indicate one of the following:

- A decline in the number of satisfied customers (implying a drop in standards of management, manufacturing or delivery).
- A drop in the standard of debt control.
- A falling-off in favour of the company's product, forcing the company to maintain turnover by selling on credit to customers to whom it could not usually offer credit.

Many companies compute a debtors turnover ratio which indicates how long, on average, customers are taking to pay their accounts. Whilst this is a useful indicator, it can hide the fact that some of these debtor accounts may be many months overdue. The **debtor age analysis** highlights this area and is a useful measurement of credit performance.

Example 1

A company calculates its debtors turnover ratio to be 60 days, which it considers reasonable. However, an examination of the debtor balances reveals the following situation:

Aged Debt Analysis

	%
Current	38
1st overdue month	27
2nd overdue month	18
3rd overdue month	6
4th overdue month	4
5th overdue month	4
6th overdue month	3
	100

You can see that debts are remaining unpaid beyond 3 months. This unsatisfactory situation would not be apparent from the debtors turnover ratio.

The above information summarises the situation, but a company will require detailed information about each customer's account. The following example is an illustration of the breakdown of customers' accounts.

Example 2

Debt Age Analysis as at 31 May

	January and earlier £	**February** £	**March** £	**April** £	**May** £
A.P. Acorn & Son	–	–	120	50	310
S. Appleyard & Co.	–	–	–	75	120
Archworth Ltd	120	–	–	35	–
Babblebrook & Co.	–	820	–	–	55
Beeston Booth Ltd	–	–	360	480	250
Brook Simpson Ltd	–	–	240	510	390
Bush & Son	–	–	160	110	430
Captown & Co.	–	75	–	160	–

If company policy is to give 30 days' credit then any amounts outstanding before April will be overdue and should be chased up. It may be that there is a query such as a credit note outstanding for faulty goods, but the sooner the query is settled, the sooner the balance will be cleared. This information is very useful and should be **acted upon** speedily to ensure payment as quickly as possible, but without harassing customers to the extent that valuable future business may be lost.

(c) Control of Creditors

Monitoring the creditors turnover period (i.e. how long the business is taking to pay its suppliers) from one period to the next will reveal:

- Whether the firm is receiving a reasonable period of credit.
- Whether it is taking full advantage of credit periods.
- Whether it is extending credit periods to dangerous levels which could lead to supplies being cut off.

Study Unit 17

Financial Mathematics I: Interest and Present Value

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A. SIMPLE INTEREST

Interest (I) is a charge for the use of money for a specific time. This charge is usually expressed as a percentage called the **rate per cent per annum** (i.e. the amount to be paid for each £100 borrowed for one year). Three factors determine the amount of interest:

- The sum of money on which the interest is payable; this is known as the **principal (P).**
- The **rate (R).**
- The length of time for which the money is borrowed.

When the interest due is added to the principal, the sum is called the **amount (A),** which is the amount to be repaid.

Simple interest is interest reckoned on a **fixed principal**. Simple interest is therefore the same for each year, and the total is found by multiplying the interest for one year by the number of years.

Example 1

(a) Find the simple interest on £200 for 3 years at 4% per annum.

$$\text{Simple interest} = £200 \times \frac{4}{100} \times 3 = £24$$

(b) Find the simple interest on £200 for 3 months at 4% per annum.

$$\text{Simple interest} = £200 \times \frac{4}{100} \times \frac{3}{12} = £2$$

To calculate the simple interest on a sum of money lent for a given time at a given rate per cent per annum, the following formula is used:

$$I = \frac{P \times R \times Y}{100} \quad (Y = \text{time in years})$$

Note that when using symbols, the multiplication sign is omitted.)

We can use this formula to solve any problem on simple interest in which we are required to find the principal, rate, time or interest. There are four quantities involved, so given any three, we can find the other one.

So, starting with the basic formula:

$$I = \frac{PRY}{100}$$

Multiplying both sides by 100 (or cross-multiplying), we get:

$$I \times 100 = PYR$$

Therefore:

$$P = \frac{I \times 100}{YR} \qquad Y = \frac{I \times 100}{PR} \qquad R = \frac{I \times 100}{PY}$$

We can summarise this position as:

$$\text{Unknown factor} = \frac{\text{Interest} \times 100}{\text{Two known factors}}$$

When you are working examples always:

- State the formula.
- Give the values to be substituted.
- See that the numbers you use are in the correct units.
- Remember to write the correct unit against the answer, not just a number only.

Example 2

(a) At what rate of simple interest will £500 earn £75 in 4 years?

$$R = \frac{I \times 100}{PY}$$

$I = £75, \quad P = £500, \quad Y = 4$

$$\text{Therefore, } R = \frac{75 \times 100}{500 \times 4} = 3.75\%$$

(b) What sum of money will earn £2.50 at 5% per annum simple interest in 1 month?

$$P = \frac{I \times 100}{YR}$$

$$I = £2.50, \quad Y = \frac{1}{12}, \quad R = 5\%$$

$$\text{Therefore, } P = \frac{2.50 \times 100 \times 12}{5 \times 1} = £600$$

(c) What sum of money will amount to £500 in 4 years at 4% per annum simple interest?

Amount is principal plus interest:

$$A = P + \frac{PYR}{100} = P\left(\frac{100 + YR}{100}\right)$$

$$P = \frac{100A}{100 + YR}$$

$A = 500, \quad Y = 4, \quad R = 4$

$$\text{Therefore, } P = \frac{100 \times 500}{100 + (4 \times 4)} = £431$$

B. COMPOUND INTEREST

In compound interest, the **interest due is added to the principal** at stated intervals, and interest is reckoned on this increased principal for the next period, and so on, the principal being increased at each period by the amount of interest then due.

Example

Find the compound interest and the simple interest on £1,000 invested at 2½ % per annum for 4 years.

			£
(a)	Principal		1,000
	add 1st year's interest at 2½%		25
	Amount at end of 1st year		1,025
	add 2nd year's interest at 2½%		25.625
	Amount at end of year 2		1,050.625
	add 3rd year's interest at 2½%		26.265625
	Amount at end of year 3		1,076.890625
	add 4th year's interest at 2½%		26.922266
	Final amount at end of 4 years	=	1,103.812891
		=	£1,103.81

Therefore, compound interest = Final amount – Principal = £1,103.81 – £1,000 = £103.81

(b) The simple interest on £1,000 at 2½ % per annum over 4 years is £25 per annum (always constant) or £100.

$$\text{i.e. } 1{,}000 \times \frac{2.5}{100} \times 4 = £100 .$$

Now work through the above example by yourself to ensure that you fully understand the principles involved, and then answer the following question.

QUESTION FOR PRACTICE ***(Answers at end of study unit)***

1. Find the amount at compound interest on £3,000 at 6 per cent per annum for 2 years. Interest is paid each six months. (Note that amount is defined as principal + interest; and that you must add the interest due to the principal each six months.)

Compound Interest Formula

If P is the principal, and if r is the rate of interest on £1 for 1 year, then the interest on P for 1 year is:

$P \times r$, written as Pr.

At the end of the 1st year the interest is added to the principal. Therefore:

The new principal at the end of year 1 = P + Pr *or* P(1 + r).

At the end of the 2nd year, the interest on the new principal, i.e. P(1 + r) is:

P(1 + r) × r *or* Pr(1 + r).

The principal at the end of the 2nd year is now P(1 + r) + Pr(1 + r). This can be written as:

(P + Pr) (1 + r), *which equals* $P(1 + r)^2$.

You will see that the new principal at the end of n years is equal to $P(1 + r)^n$, and we therefore have the formula for the evaluation of compound interest, which is:

$$A = P(1 + r)^n$$

where: A = final amount

P = original sum invested

r = rate of interest per annum on £1

n = number of years

Remember that r is the rate of interest on £1 for 1 year. Therefore, if the question refers to a rate of interest of 5 **per cent** per annum,

$$(1 + r) \text{ becomes } 1 + \frac{5}{100} = 1.05$$

You must become accustomed to thinking in these terms, so that visualising the formula becomes automatic. Learn the formula by heart. Say it to yourself over and over again until it is firmly imprinted on your mind.

Having now learned and understood the formula $A = P(1 + r)^n$ you will find that the real problem lies in the evaluation of $(1 + r)^n$. This is most conveniently done by the use of a calculator or by logarithms, especially when n is large. It is usual to use seven-figure logarithms, as four-figure tables are not sufficiently accurate for compound interest calculations.

Example 1

Find the compound interest on £1,000 for 3 years at 2½ % per annum. Give the answer to the nearest penny.

Method (a): Using 4-figure logarithms

$$A = P(1 + r)^n = 1{,}000\ (1.025)^3$$

$$\log A = \log 1{,}000 + (3 \times \log 1.025)$$

$$= 3.0000 + (3 \times 0.0107)$$

$$= 3.0000 + 0.0321 = 3.0321$$

Therefore, A = antilog 3.0321 = £1,076.00

Therefore, compound interest = A – P = £1,076 – £1,000 = £76

Method (b): Using ordinary multiplication (i.e. a calculator)

$$A = P(1 + r)^n = 1{,}000\ (1.025)^3$$

$$= 1{,}000\ (1.025 \times 1.025 \times 1.025) = 1{,}000 \times 1.076890625$$

$= 1{,}076.890625 = £1{,}076.89$

Therefore, compound interest $= A - P = £1{,}076.89 - £1{,}000 = £76.89$

You will see that method (b) differs from method (a) by 89p. This example serves to illustrate the danger of using 4-figure logarithms in solving a problem requiring a high degree of accuracy.

Method (c): Using 7-figure logarithms

Now let us see what answer we obtain by using 7-figure logarithms.

$\log A = \log 1{,}000 + (3 \times \log 1.025)$ *(found from method (a))*

$= 3.0000 + 3 \times 0.0107239 = 3.0321717$

$A = \text{antilog } 3.0321717 = £1{,}076.89$

Therefore, compound interest $= A - P = £76.89$

Thus 7-figure logarithms give acceptable accuracy.

Example 2

Calculate the compound interest to the nearest penny on £1,000 for 2 years at 6 % per annum, interest being calculated each six months.

$A = P(1 + r)^n = 1{,}000\,(1.03)^4$

$= 1{,}000\,(1.03 \times 1.03 \times 1.03 \times 1.03)$

$= 1{,}000 \times 1.12550881 = 1{,}125.50881 = £1{,}125.51$

Therefore, compound interest $= A - P = £1{,}125.51 - £1{,}000$

$= £125.51$ to the nearest penny

Having worked carefully through the preceding examples, try to answer the following questions.

QUESTIONS FOR PRACTICE

2. What is the compound interest on £80 in 3 years, interest being at the rate of 5 % per annum?
3. Find by how much the amount at compound interest exceeds the amount at simple interest on a sum of £1,288 for 3 years at 2½ % per annum.

Additional Investment

Suppose you decide to invest £2,000 at the beginning of a particular year and that you add £100 to this investment at the end of each year. If interest is compounded at 9 % per annum, then we can deduce:

The amount invested at the end of the first year is:

$£2{,}000(1 + 0.09) + £100$

The amount invested at the end of the second year is:

$£2{,}000(1 + 0.09)^2 + £100(1 + 0.09) + £100$

The amount invested at the end of the nth year is:

$£2{,}000(1 + 0.09)^n + £100(1 + 0.09)^{n-1} + £100(1 + 0.09)^{n-2} + \ldots + £100(1 + 0.09) + £100$

Ignoring the first term on the right-hand side, the other terms can be written:

$$£100 + £100(1 + 0.09) + \ldots + £100(1 + 0.09)^{n-2} + £100(1 + 0.09)^{n-1}$$

i.e. they form a GP with first term £100 and common ratio (1 + 0.09). Thus, using the formula for the sum of n terms of a GP, these terms can be written more concisely as:

$$£100\frac{\left(1.09^{n}-1\right)}{1.09-1} = £100\frac{\left(1.09^{n}-1\right)}{0.09}$$

Supposing we wish to know the amount invested after 3 years, then we put n = 3.

$$\begin{aligned}\text{Amount} &= £2{,}000(1.09)^3 + £100\frac{\left(1.09^{3}-1\right)}{0.09} \\ &= £2{,}590.06 + £327.81 = £2{,}917.87\end{aligned}$$

In general, if an amount P is invested at the beginning of a year and a further amount **a** is invested at the end of each year, then the sum, S, invested after n years is:

$$\begin{aligned}S &= P(1 + r)^{n} + a(1 + r)^{n-1} + a(1 + r)^{n-2} + \ldots + a(1 + r) + a \\ &= P(1 + r)^{n} + a\frac{(1+r)^{n}-1}{(1+r)-1} \\ &= P(1 + r)^{n} + a\frac{(1+r)^{n}-1}{r} \\ &= \left(P + \frac{a}{r}\right)(1+r)^{n} - \frac{a}{r}\end{aligned}$$

It is probably not worthwhile trying to remember this formula but you should know how to obtain it and apply it to specific examples. Similar reasoning can of course be applied when the investment is reduced by a constant amount.

QUESTIONS FOR PRACTICE

4. You win £1,500 on the football pools which you invest on the stock market. Your accountant advises you that the value of your investment can be expected to grow by 8% per annum. Estimate the value of the investment after 8 years. You now decide to make an additional annual investment of £100. If the first purchase is made one year after your pools win, estimate the value of the investment after 8 years.

5. The managing director is due to retire at the end of the year and the board vote that an income of £12,000 p.a. be paid to him or his family for 10 years. You, as the company accountant, have been instructed to set aside now, a sum of money from which the income will be paid. If the fund can be invested at 8% per annum, how much should you set aside? (Hint: the sum invested at the end of the period will be zero.)

C. PRESENT VALUE

The present value of a future sum of money is best defined as the principal which will amount to a **given** sum of money in a **given** number of years invested at compound interest".

Consider the equation $A = P(1 + r)^n$

By simply dividing by $(1 + r)^n$, we have $\frac{A}{(1+r)^n} = P$

This gives us the equation for calculating present value:

$$\frac{A}{(1+r)^n}$$

Example 1

What is the present value of £1,000 due in 3 years? (Interest is compound at 2½ % per annum.)

$$\text{Present value} = \frac{A}{(1+r)^n} = \frac{1{,}000}{(1.025)^3} = \frac{1{,}000}{1.076890625}$$

$$= \text{£}928.60 \text{ to nearest p}$$

Example 2

What is the present value of a claim for £1,500 due in 3 years at 5 % per annum? Answer to nearest penny.

$$\text{Present value} = \frac{A}{(1+r)^n} = \frac{1{,}500}{(1.05)^3} = \frac{1{,}500}{1.157625}$$

$$= \text{£}1{,}295.756 = \text{£}1{,}295.76 \text{ to nearest p}$$

A table showing the present value of £1 received or paid over n years is given in the Appendix to Unit 18. Using these tables for Example 2, where r = 5 per cent and n = 3 years, we have:

PV of £1 = £0.8638

Therefore, PV of £1,500 = £0.8638 × 1,500 = £1,295.70

This agrees with our previous answer. In the next study unit we shall make more use of PV tables.

QUESTIONS FOR PRACTICE

6. What sum invested now would yield £1,000 after 5 years at compound interest rate 5% per annum?

7. A manufacturer proposes to purchase some machinery. Under the terms of the contract he has to pay £2,500 now and £7,500 in two years' time. What is the present cash value using a 6% interest rate compounded annually?

Application to Business Decision-Making

(a) Annuities

An application of the concept of present value is to annuities. An annuity is an investment which earns interest for a number of years but from which we draw a given sum of money each year until the capital and interest are exhausted. We have in fact tackled this type of question (in Practice Question 5) but we shall now look at annuities using the concept of present value.

Consider an annuity yielding £a per year when the rate of interest is r per £1 per annum over a period of n years.

$$\text{PV of £a receivable one year hence} = £\frac{a}{1+r}$$

$$\text{PV of £a receivable two years hence} = £\frac{a}{(1+r)^2}$$

$$\text{PV of £a receivable n years hence} = £\frac{a}{(1+r)^n}$$

Therefore, the total present value of the annuity is (in £):

$$\frac{a}{(1+r)}+\frac{a}{(1+r)^2}+\ldots+\frac{a}{(1+r)^n}$$

This is a GP with first term $\frac{a}{1+r}$, ratio $\frac{1}{1+r}$.

$$\text{Its sum} = \frac{a}{(1+r)}\frac{\left[1-\left(\frac{1}{1+r}\right)^n\right]}{1-\frac{1}{(1+r)}}$$

$$= \frac{a}{(1+r)}\frac{\left[1-(1+r)^{-n}\right]}{\frac{r}{(1+r)}}$$

$$= a\frac{\left[1-(1+r)^{-n}\right]}{r}$$

Using our earlier example (Practice Question 5) we have

a = £12,000, r = 0.08, n = 10

Thus the present value of the annuity is:

$$£12{,}000 \times \left[\frac{1-(1.08)^{-10}}{0.08}\right] = £\frac{12{,}000}{0.08}\times\left[1-0.46319\right]$$

$$= £80{,}521$$

which agrees with the earlier result.

QUESTIONS FOR PRACTICE

8. On retiring at 65, a male employee can choose between a terminal gift of £2,000 or a pension amounting to £450 per year for life. Assume a rate of interest of 5% and that a man aged 65 has a life expectancy of 7 years, to work out which option the employee should choose. (You may assume that the lump sum would not be invested.)

9. In order to purchase a property for £20,000 a loan of £15,000 is negotiated with a finance company. The balance of £5,000 is to be paid out of personal resources. The terms of the loan are as follows:

   - Duration of the loan is for 15 years.
   - Rate of interest is fixed at 10% per annum throughout the 15 years. The annual interest charge is to be calculated on the balance outstanding at the beginning of each year.
   - Repayment is to be in 15 equal annual instalments.
   - Each instalment will include both interest and capital.

   You are required to calculate the amount to be paid each year on the loan of £15,000.

(b) Amortisation of a Debt

It is often necessary to work out the amount that must be paid at regular intervals to clear a loan or mortgage. For example, if a mortgage of £12,500 repayable over 25 years is taken out at a rate of 14% per annum, what annual repayments are required to clear the loan, assuming the interest rate does not change?

Method (i)

Let £X be the annual repayment.

At the end of the first year, £X is repaid so the amount (in £) outstanding is:

$$12{,}500\,(1 + r) - X$$

At the end of the second year, £X is repaid and the amount (in £) outstanding is:

$$12{,}500\,(1 + r)^2 - X(1 + r) - X$$

Similarly after 25 years, the amount (£) outstanding is:

$$12{,}500\,(1 + r)^{25} - X(1 + r)^{24} - X(1 + r)^{23} - \ldots - X(1 + r) - X$$

However, this amount must be zero to clear the loan.

Therefore,

$$12{,}500\,(1 + r)^{25} - X(1 + r)^{24} - X(1 + r)^{23} \ldots - X(1 + r) - X = 0$$

$$X[1 + (1 + r) + (1 + r)^2 + \ldots + (1 + r)^{23} + (1 + r)^{24}] = 12{,}500\,(1 + r)^{25}$$

$$X\left[\frac{(1+r)^{25} - 1}{(1+r) - 1}\right] = 12{,}500(1+r)^{25}$$

Where we have used

$$S_n = a\frac{(r^n - 1)}{r - 1}, \text{ for the sum of a GP.}$$

Therefore:

$$X\frac{(1+r)^{25}-1}{r}=12{,}500(1+r)^{25}$$

$$X = \frac{12{,}500(1+r)^{25}r}{(1+r)^{25}-1} = 1{,}818.73\text{, putting } r = 0.14$$

Thus 25 annual repayments of £1,818.73 are needed to clear the loan.

Method (ii)

Let £X be the annual repayment.

The present value (£) of £X payable 25 years hence is $\frac{X}{(1+r)^{25}}$

The present value (£) of £X payable 24 years hence is $\frac{X}{(1+r)^{24}}$

Similarly, the present value (£) of £X payable one year hence is $\frac{X}{(1+r)}$.

The sum of all these present values must equal £12,500, the amount of the loan.

Therefore:

$$\frac{X}{(1+r)^{25}} + \frac{X}{(1+r)^{24}} + \dots + \frac{X}{(1+r)} = 12{,}500$$

$$X\left[\frac{1}{(1+r)^{25}}+\frac{1}{(1+r)^{24}}+\dots+\frac{1}{1+r}\right]=12{,}500$$

$$X\left(\frac{1}{1+r}\right)\left[\frac{1-\frac{1}{(1+r)^{25}}}{1-\frac{1}{1+r}}\right]=12{,}500$$

where we have used

$$S_n = a\frac{(1-r^n)}{1-r} \text{ for the sum of a GP}$$

Therefore:

$$\frac{X}{r}\left[1-\frac{1}{(1+r)^{25}}\right]=12{,}500$$

$$X = \frac{12{,}500(1+r)^{25}r}{(1+r)^{25}-1}$$

This is identical to the formula obtained using Method (i).

QUESTIONS FOR PRACTICE

10. £20,000 is borrowed from a building society, repayable over 20 years at 14% per annum compound interest. How much must be repaid each year?

11. On 31 December Year 1 a man borrowed £100. The terms of the loan were:

    (i) Interest to be compounded at 6% p.a.

    (ii) He would repay £20 each 31 December.

    By 31 December Year 6 he had, in fact, saved enough money to pay off the loan with interest in full. What sum did he repay?

D. TO FIND THE RATE OR THE NUMBER OF YEARS

Having learned the formula $A = P(1 + r)^n$ and having worked through the examples shown, you can use the formula for finding the rate per cent or the number of years, provided A and P are given or a relationship between them is established.

Example 1

In how many years will £100 amount to £112.36 at 6% compound interest, interest being computed yearly?

Formula is: $A = P(1 + r)^n$

In this case: P = £100, and A = £112.36

$$\text{Therefore,}\quad 112.36 = 100(1 + 0.06)^n$$

$$1.1236 = 1.06^n$$

This expression can be solved by taking logarithms of both sides of the equation:

$$\log 1.06^n = \log 1.1236$$

$$n\log 1.06 = \log 1.1236$$

$$n = \frac{\log 1.1236}{\log 1.06} = \frac{0.0506}{0.0253}$$

$$= 2 \text{ years}$$

Example 2

At what rate per cent will a principal of £100 amount to £115.76 in 3 years?

Formula is: $A = P(1 + r)^n$

In this case: P = £100, and A = £115.76

$$\text{Therefore,}\quad 115.76 = 100(1 + r)^3$$

$$1.1576 = (1 + r)^3$$

$$(1 + r) = \sqrt[3]{1.1576} = (1.1576)^{1/3}$$

To evaluate $(1.1576)^{1/3}$, we must use either a calculator with an $X^{1/Y}$ facility or logarithms.

- Using a calculator, $(1.1576)^{1/3} = 1.05$
- Using logarithms,

$$\log\ (1.1576)^{1/3} = \tfrac{1}{3}\log 1.1576 = \frac{0.0636}{3} = 0.0212$$

$$(1.1576)^{1/3} = \text{antilog } 0.0212 = 1.05$$

$$1 + r = 1.05$$

$$r = 0.05$$

i.e. rate of interest is 5% per annum.

QUESTION FOR PRACTICE

12. If the sum of £1,000 becomes £1,210 after 2 years, find the accumulated amount (to the nearest £) after 4 years, assuming a constant rate of compound interest.

E. DEPRECIATION

Depreciation is a loss in value. Such things as land, buildings, machinery, furniture and fixtures are the fixed assets of a business. These may drop in value, but their true market value must be recorded periodically as a book value. The depreciation can be calculated either on a straight line method, i.e. a **fixed sum** over the life of the asset, or on a reducing (or diminishing) balance method where the book value is reduced by a **fixed percentage** each year.

Example 1

Company A bought a fleet of 20 cars for its salesmen each costing £5,250. It decided to write off equal instalments of the capital cost over 5 years. Company B bought an exactly similar fleet but it decided to write off 20% of their value each year. Calculate the value of the cars to Company A and to Company B at the end of the third year.

Capital outlay = £5,250 × 20 = £105,000

- Company A (straight-line method):

$$\text{Depreciation for 3 years} = £\frac{105{,}000}{5} \times 3 = £63{,}000$$

Company A value at the end of 3 years = £42,000

- Company B (reducing balance method):

$$\text{Depreciation during first year} = £\frac{20}{100} \times 105{,}000 = £21{,}000$$

Book value after Year 1 = £84,000

$$\text{Depreciation during second year} = £\frac{20}{100} \times 84{,}000 = £16{,}800$$

Book value after Year 2 = £67,200

Depreciation during third year $= £\frac{20}{100} \times 67{,}200 = £13{,}440$

Book value after Year 3 $= £53{,}760$

Example 2

The furniture and fixtures of a building cost £12,000. The firm writes off 6% at the end of each year as depreciation. What will be their book value after 3 years?

Depreciation during 1st year $= £\frac{6}{100} \times 12{,}000 = £720$

Book value after one year $= £12{,}000 - £720 = £11{,}280$

Depreciation during 2nd year $= £\frac{6}{100} \times 11{,}280 = £676.80$

Book value after two years $= £11{,}280 - £676.80 = £10{,}603.20$

Depreciation during 3rd year $= £\frac{6}{100} \times 10{,}603.20 = £636.19$

Book value after 3 years $= £10{,}603.20 - £636.19 = £9{,}967.01$

We can rewrite the above example in general terms. Let £P be the original value and let r be the rate of depreciation on £1 per year. The problem is to find the book value after n years.

Depreciation during 1st year $= £Pr$

Book value after one year $= £P - £Pr = £P(1 - r)$

Depreciation during 2nd year $= £P(1 - r)r$

Book value after two years $= £P(1 - r) - £P(1 - r)r$

$= £P(1 - r)(1 - r) = £P(1 - r)^2$

After n years, book value $= £P(1 - r)^n$

You can check that this gives the same answer as before by substituting r = 0.06, n = 3 and P = £12,000.

Sometimes we need either to calculate the annual rate of depreciation or the number of years before the book value drops below a certain figure. Calculations of this type involve the use of logs to solve the equation for r or n and you should study the following examples carefully to make sure that you understand every step.

Example 3

It is estimated that a machine costing £5,000 will have a saleable value of £2,048 after four years. Find the depreciation rate per cent to be applied during the four years' life assuming the reducing balance method of depreciation is used.

P = £5,000, n = 4, r = rate of depreciation on £1 per year

Book value after 4 years = £2,048

but this book value also equals $£5{,}000(1 - r)^4$

i.e. $2{,}048 = 5{,}000(1 - r)^4$

To solve equations of this type, always isolate the term containing the power:

$$(1 - r)^4 = \frac{2{,}048}{5{,}000} = 0.4096$$

$$(1 - r) = 0.4096^{1/4}$$

Using a calculator, $0.4096^{1/4} = 0.8$

Using logarithms:

$$\log 0.4096^{1/4} = \tfrac{1}{4} \log 0.4096 = \frac{\bar{1}.6124}{4}$$

$$= \frac{-1 + 0.6124}{4} = \frac{-0.3876}{4}$$

$$= -0.0969$$

Thus $(1 - r) = \text{antilog}(-0.0969)$

We cannot look up the log of a negative number so we must rewrite it in bar number form first, i.e.

$$(1 - r) = \text{antilog}(\bar{1}.9031)$$

$1 - r = 0.8000$ using tables of antilogs

$$1 - 0.8000 = r$$

$$r = 0.2$$

Thus the depreciation rate **per cent** is $0.2 \times 100 = 20\%$

Sinking Funds

Usually a company puts aside a regular sum of money into a sinking fund so that, when a piece of machinery has to be replaced, the cost of its replacement can be met from the fund.

Example

A machine has an expected life of seven years and its replacement price is expected to be £5,000. How much money should be set aside each year to cover this replacement cost if the money can be invested at 7% per annum?

Let £a be the sum invested at the end of each year.

Value of investment (in £) at end of Year 1 $= a$

Value of investment (in £) at end of Year 2 $= a + a(1 + 0.07)$

Value of investment (in £) at end of Year 3 $= a + a(1 + 0.07) + a(1 + 0.07)^2$

Value of investment (in £) at end of Year 7 $= a + a(1 + 0.07) + a(1 + 0.07)^2 + \ldots + a(1 + 0.07)^6$

This can be simplified as it is a GP with common ratio 1.07. Therefore:

$$\text{Value at end of year 7} = £a\frac{(1.07^7 - 1)}{1.07 - 1}$$

$$= £a\frac{(1.60578 - 1)}{0.07} = £a\frac{0.60578}{0.07}$$

However, we are told that this value has to be £5,000. Therefore:

$$5{,}000 = a\frac{0.60578}{0.07}$$

$$a = \frac{350}{0.60578} = 578 \text{ to nearest whole number}$$

Therefore the amount to be set aside each year in the sinking fund is £578.

Once again this formula can be generalised. If at the end of each year a sum £a is invested at rate r per £1 per annum and the process is repeated for n years, then the value, £T, of the investment after n years is given by the sinking fund formula:

$$T = a\frac{(1+r)^n - 1}{r}$$

You should try to obtain this result yourself.

QUESTIONS FOR PRACTICE

13. A machine costing £5,000 will have an estimated useful life of 5 years after which its scrap value will be £389. If the reducing balance method of depreciation is to be used, find the annual percentage rate of depreciation.

14. An asset costing £40,000 is expected to have a useful life of 20 years after which its scrap value will be £4,000. If the reducing balance method of depreciation is to be used, find the annual percentage rate of depreciation.

ANSWERS TO QUESTIONS FOR PRACTICE

1. 2 years at 6 per cent per annum = 4 payments at 3 per cent

	£
Principal	3,000
Add interest for 6 months at 3%	90
	3,090
Add interest for 6 months at 3%	92.70
Amount at end of year 1	3,182.70
Add interest for 6 months at 3%	95.481
	3,278.181
Add interest for 6 months at 3%	98.34543
Amount at end of second year	£3,376.52643
=	£3,376.53

2. $A = P(1 + r)^n = 80(1.05)^3 = 92.61$

   Interest = £12.61

3. $A = P(1 + r)^n = 1{,}288(1.025)^3$

   $= 1{,}288 \times 1.076890625 = 1{,}387.035125$

   Compound interest = £1,387.035125 – £1,288 = £99.035125

   = £99.04

   Simple interest $I = \dfrac{Prn}{100} = \dfrac{1{,}288 \times 2½ \times 3}{100}$

   $= \dfrac{1{,}288 \times 5 \times 3}{200} = £96.60$

   Answer = £99.04 – £96.60 = £2.44

4. a = £1,500, r = 0.08, and n = 8

   $S = P(1 + r)^n = 1{,}500(1.08)^8 = 1{,}500 \times 1.85093$

   = 2,776 to nearest whole number

   Value of investment after 8 years is £2,776 to the nearest £.

For the new investment:

After 1 year, value of investment = £1,500 (1.08) + £100

After 2 years, value of investment = £1,500 $(1.08)^2$ + £100 (1.08) + £100

After 8 years, value of investment = £1,500 $(1.08)^8 + 100\dfrac{\left(1.08^8 - 1\right)}{0.08}$

= £2,776 + £1,064 = £3,840 to nearest £1

5. Let the amount invested originally be £P

After 1 year:

Value of investment = £P(1.08) – £12,000

After 2 years:

Value of investment = £P$(1.08)^2$ – £12,000(1.08) – £12,000

After 10 years:

Value of investment = £P$(1.08)^{10} - £12{,}000\dfrac{\left(1.08^{10} - 1\right)}{0.08}$

As the fund is exhausted after 10 years, this value must be zero, so:

$$P(1.08)^{10} = 12{,}000\frac{\left(1.08^{10} - 1\right)}{0.08}$$

$$\text{i.e.} \quad P = \frac{12{,}000(1.08^{10} - 1)}{1.08^{10} \times 0.08}$$

$$= \frac{13{,}907.10}{0.1727} = 80{,}520.96$$

The accountant should set aside £80,521.

6. PV = $£\dfrac{1{,}000}{(1+0.05)^5} = £783.53$ to the nearest p

7. PV of £7,500 payable in 2 years' time = $£\dfrac{7{,}500}{(1+0.06)^2} = £\dfrac{7{,}500}{1.1236}$ = £6,674.97 to nearest p

Therefore total cash value = £2,500 + £6,674.97

= £9,174.97 to nearest p

8. PV of £450 per year for 7 years at 5% pa compound interest

$$= £\,450\left[\frac{1-(1.05)^{-7}}{0.05}\right] = £450\frac{(1-0.71068)}{0.05}$$

= £2,603.88 to nearest p

This is greater than £2,000 so the employee should choose the pension.

9. Let £X be the amount payable each year.

Amount outstanding at end of Year 1 = 15,000(1 + r) – X

Amount outstanding at end of Year 2 = $15{,}000(1 + r)^2 - X(1 + r) - X$

Amount outstanding at end of Year 15 = $15{,}000(1+r)^{15} - X(1+r)^{14} - \ldots - X(1+r) - X = 0$

Therefore:

$$15{,}000(1+r)^{15} = X\left[\frac{(1+r)^{15}-1}{(1+r)-1}\right]$$

$$X = \frac{15{,}000r(1+r)^{15}}{(1+r)^{15}-1} = \frac{15{,}000\times 0.1\times 1.1^{15}}{1.1^{15}-1} \text{ since } r = 0.1$$

= £1,972.11 to nearest p

10. Let X be the annual repayment

$$20{,}000(1+r)^{20} - X\left[1+(1+r)+(1+r)^2+\ldots+(1+r)^{19}\right] = 0$$

Therefore, $20{,}000(1+r)^{20} = X\left[\frac{(1+r)^{20}-1}{r}\right]$

$$X = \frac{20{,}000(1+r)^{20}r}{(1+r)^{20}-1}$$

$$= \frac{20{,}000\times(1.14)^{20}\times 0.14}{(1.14)^{20}-1}$$

$$= \frac{20{,}000\times 13.74349\times 0.14}{12.74349} = 3{,}019.72$$

Hence £3,020 (correct to the nearest £) must be repaid each year.

11. Sum owing at end of Year 2 is (in £) = 100(1 + 0.06) – 20

At the end of Year 6 the balance outstanding, before the normal £20 repayment, is:

$$100(1+0.06)^5 - 20(1+0.06)^4 - 20(1+0.06)^3 - 20(1+0.06)^2 - 20(1+0.06)$$

$$= 100(1+0.06)^5 - 20(1+0.06)\left(1+1.06+1.06^2+1.06^3\right)$$

$$= 133.82 - 92.74 = 41.08$$

Settlement figure at the end of Year 6 is £41.08.

12. $A = P(1 + r)^n$

$1{,}210 = 1{,}000(1 + r)^2$

$(1 + r)^2 = 1.210$

$(1 + r) = \sqrt{1.21} = 1.1$

Therefore, r = 0.1 and the rate of interest is 10 per cent.

We must find, therefore, the value of either £1,000 at 10% pa for 4 years, or alternatively the value of £1,210 at 10% pa for 2 years.

$A + P(1 + r)^n$

Therefore, $A = 1{,}000(1.1)^4$

$= 1{,}000 \times 1.4641 = £1{,}464.10$

The alternative is as follows:

$A = P(1 + r)^n$

$= 1{,}210(1.1)^2 = 1{,}210 \times 1.21 = £1{,}464.10$

13. After 5 years, value = £5,000 $(1 – r)^5$

but this must equal £389

i.e. $5{,}000(1 – r)^5 = 389$

$(1 – r)^5 = 0.0778$

$5 \log (1 – r) = \log 0.0778$

$5 \log (1 – r) = \bar{2}.8910$

$5 \log (1 – r) = –1.1090$

$\log (1 – r) = –0.2218 = \bar{1}.7782$

$(1 – r) = 0.60$

$r = 0.40$

Therefore, annual percentage rate of depreciation is 40%

14. $40{,}000(1 - r)^{20} = 4{,}000$

$$(1 - r)^{20} = 0.1$$

$$20 \log (1 - r) = \log 0.1 = -1$$

$$\log (1 - r) = -0.05 = \bar{1}.9500$$

$$1 - r = 0.8913$$

$$r = 0.1087$$

i.e. Annual percentage rate of depreciation is 10.9%

Study Unit 18

Financial Mathematics II: Capital Investment Appraisal

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INTRODUCTION

If a business is to continue earning profit, its management should always be alive to the need to replace or augment fixed assets. This usually involves investing money (capital expenditure) for long periods of time. The longer the period, the greater is the uncertainty and, therefore, the risk involved. With the advent of automation, machinery, equipment and other fixed assets have tended to become more complex and costly. Careful selection of projects has never been so important. The principal methods of selecting the most profitable investments are discussed below.

These methods do not replace judgement and the other qualities required for making decisions. However, it is true to say that the more information available, the better a manager is able to understand a problem and reach a rational decision.

Classification of Investment Problems

Capital investment problems may be classified into the following types, and each may require a different method of calculation:

(a) The replacement of, or improvement in, existing assets by more efficient plant and equipment (often measured by the estimated cost savings).

(b) The expansion of business facilities to produce and market new products (measured by the forecast of additional profitability against the proposed capital investment).

(c) Decisions regarding the choice between alternatives where there is more than one way of achieving the desired result.

(d) Decisions whether to purchase or lease assets.

Methods of Decision-Making

The main methods used for deciding the most profitable project from a number of investments are:

(a) Payback method (also known as payback period method).

(b) Return on investment or average rate of return method.

(c) Discounted cash flow method, which may be subdivided into:

- Yield method or internal rate of return method.
- Net present value method.

We shall now discuss each of these methods in greater detail.

A. PAYBACK METHOD

The payback method ranks investments in order of preference by referring to the period in which each investment is expected to pay for itself.

If an investment is expected to produce a uniform cash return that is constant from year to year, the following formula may be used:

$$\text{Payback period in years} = \frac{\text{Cash outlay}}{\text{Annual increase in income or saving in cost}}$$

If the cash return is not constant from year to year then the payback period must be determined by adding up the proceeds expected in successive years, until the total equals the cash outlay.

If two machines will fulfil the same purpose, and are being compared, the one which is expected to earn sufficient to cover its cost in the shorter time will be the one selected. A simple example will illustrate the principle.

Yearly earnings of machines A and B:

		Machine A £	**Machine B** £
Net earnings:	Year 1	5,000	4,000
	Year 2	5,000	4,000
	Year 3	–	4,000
Total earnings		£10,000	£12,000
Capital cost		£10,000	£10,000
Payback period		2 years	2½ years

Under the payback method, Machine A would be the better investment.

The payback method has many weaknesses. As you can see from the example given, no account is taken of the fact that earnings may accrue after the payback period has expired. Machine A earns nothing in the third year and in fact produces no profit, simply covering the original cost. In other words, the true profitability is not considered. A further disadvantage may arise from the fact that some companies have a policy of limiting possible investments to those with a reasonably short life, up to, say, five years. Many profitable investments may have a longer life than five years and yet, because of the rule, are excluded from consideration.

Another serious criticism of this method is the inaccuracy which must inevitably arise from ignoring the timing of receipts. Money expected in the future should not be taken at its face value. If there are two possible investments, costing the same to purchase, with earnings occurring as shown below, can it be said that they are equally attractive?

		Machine X £	Machine Y £
Net earnings:	Year 1	1,000	6,000
	Year 2	1,000	3,000
	Year 3	8,000	1,000
Total earnings		£10,000	£10,000

Although they both show equal earnings, Machine Y will be preferred because the bulk of the earnings are expected in the first two years. The £8,000 due from Machine X in the third year is so remote in time that a large discount would have to be deducted to arrive at the present value. This matter is discussed further under third method of deciding investments – discounted cash flow.

The limitations of the payback method should not be allowed to give the impression that it should never be used. When assets being considered have equal lives, the payback method may give quite a good ranking of investments. The fact that only short periods are usually considered means that forecasting is more certain and, furthermore, there is less danger of obsolescence.

B. RETURN ON INVESTMENT METHOD

The investment which shows the higher rate of return is taken to be the most profitable investment. Unfortunately, there is no standardised method of calculating the average rate of return, and the methods that are used may show different rankings for investments. Three possible methods are: return per £1 invested; percentage rate of return; average annual return per £1 invested. These are explained by reference to the example relating to machines A and B given earlier.

Return per £1 Invested

	Machine A £	Machine B £
Earnings	10,000	12,000
Investment	10,000	10,000
Return per £1 invested	£1	£1.2

Percentage Rate of Return

The return per £1 invested can be expressed in percentage form as follows:

$$\frac{\text{Total earnings}}{\text{Total investment}} \times 100$$

Not all accountants advocate the use of this formula, and there are many alternatives. Some use the average annual earnings, others the annual net profit; many accountants prefer the use of an average investment obtained by dividing the total investment by two. This principle is based on the assumption that straight-line depreciation is charged, which gives an average investment which is approximately half of the total being invested.

Using the formula shown, the results are:

$$\text{Machine A } \frac{£10{,}000}{£10{,}000} \times 100 = 100\%$$

$$\text{Machine B } \frac{£12{,}000}{£10{,}000} \times 100 = 120\%$$

Average Annual Return per £1 Invested

	Machine A £	Machine B £
Earnings	10,000	12,000
Average annual earnings	5,000	4,000
Investment	10,000	10,000
Return per £1 invested	£0.5	£0.4

The return per £1 invested should be self-explanatory. In the first example the investment cost is divided into the earnings. The result in the above table is obtained by dividing investment cost into average annual earnings. This latter method purports to show that Machine A is the better investment even though the total return is less than from Machine B. This is a weakness of the method. Only when the serviceable life of each machine is of equal length can comparable results be obtained.

C. INTRODUCTION TO DISCOUNTED CASH FLOW METHODS

The discounted cash flow (DCF) method can be used to overcome most of the disadvantages of the previous methods since it takes into account the time span and distribution of earnings and expenditure. It uses the concepts and formulae of compound interest.

Basis of the Method

The method is based on the criterion that the total present value of all increments of income from a project should, when calculated at a suitable rate of return on capital, be at least sufficient to cover the total capital cost. It takes account of the fact that the earlier the return the more valuable it is, for it can be invested to earn further income.

By deciding on a satisfactory rate of return for a business, this can then be applied to several projects over their total life to see which gives the best present cash value.

For any capital investment to be worth while it must give a return sufficient to cover the initial cost and also a fair income on the investment. The rate which will be regarded as “fair income” will vary with different types of business, but as a general rule it should certainly be higher than could be obtained by an equivalent investment in shares.

Information Required

To make use of DCF we must have **accurate** information on a number of points. The method can only be as accurate as the information which is supplied. This information will have to be collected by other means before we can attempt a DCF assessment, and in an examination you will always be given the appropriate details (or some means of discovering them).

The following information is necessary as a basis for calculation:

- Estimated cash expenditure on the capital project.
- Estimated cash expenditure over each year.
- Estimated receipts each year, including scrap or sale value, if any, at the end of the asset's life.
- The life of the asset.
- The rate of return expected (in some cases you will be given a figure for cost of capital and you can easily use this rate in the same way to see whether the investment is justified).

The **cash flow** each year is the actual amount of cash which the business receives or pays each year in respect of the particular project or asset (a net figure is used). This represents the difference between (c) and (b).

Clearly the receipts and expenditures may occur at irregular intervals throughout the year, but calculations on this basis would be excessively complicated for problems such as may arise in your examination. So unless you are told otherwise you can assume that the net receipt or expenditure for the year occurs at the **end** of the relevant year.

Importance of Present Value

Before we proceed to a detailed examination of the method used by DCF there is one important concept which you must understand – the idea of **present value**.

Anyone offered the choice of £100 now or £100 in a year's time would choose the £100 now. This would apply even if the person concerned intended to save the money until next year anyway, because by obtaining the same sum a year earlier, it could be put to use and interest could be obtained. Thus if an investment could be found which gave a rate of return of 10%, the £100 now would be worth £110 in a year's time. Conversely the present value of £110 in a year's time is £100 because at the stated interest rate this is the present-day sum which represents £110 in a year's time.

Now take a businessman who is buying a machine. It will give him, say, an output worth £100 at the end of the first year, and the same at the end of each successive year. He must bear this in mind when buying the machine which costs, say, £1,000. But he must pay out the £1,000 now. His income, on the other hand, is not worth its full value now, because it will be a year before he will receive the first £100, two years before he will receive the second £100, and so on. So if we think of the present value of the income which he is to receive, the first £100 is really worth less than £100 **now**, and the second is worth less still. In fact, the present value of each increment of £100 is the sum now which, at compound interest, will represent £100 when the sum falls due.

This can easily be calculated, or it may be ascertained from **present value tables**, which take account of time and of varying interest rates. An example of such tables are set out in the Appendix to this unit and are easily used.

We can see, for example, that if we assume a cost of capital of 7%, £1 in two years' time is worth £0.8734 **now**. This is the sum which would grow to £1 in two years at compound interest of 7%.

Thus we have established the present value of £1.00 in 2 years' time, discounted at compound interest of 7%.

We can now look again at the businessman and his machine. The present value of the first year's income (received at the end of the year, for the purposes of this example) is 100 × £0.9346, if we assume that his cost of capital is also 7%; the present value of the second year's income is 100 × £0.8734. The same method can be used for succeeding years in the same way.

Present value tables can usually be used when you are required to undertake calculations. However, for a fuller understanding of the discounting theory, we shall now consider the formula used to arrive at these factors.

From the previous study unit, we have:

$$PV = \frac{C}{(1+r)^n}$$

where: PV = Present value

C = Cash flow

r = Rate of interest on £1 for 1 year

n = Number of years

When cash flows are spread over a number of years the formula is expanded to:

$$\frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} \cdots \frac{C_n}{(1+r)^n}$$

where: C_1 = Cash flow in year 1

C_2 = Cash flow in year 2, etc.

Example

£1 to be invested for 3 years, discounted at 10% per annum.

		Factor
Present value of £1 receivable in one year's time	$= \frac{1}{(1+0.1)} = \frac{1}{1.1}$	= £0.9091
Present value of £1 receivable in two years' time	$= \frac{1}{(1.1)^2} = \frac{1}{1.21}$	= £0.8264
Present value of £1 receivable in three years' time	$= \frac{1}{(1.1)^3} = \frac{1}{1.331}$	= £0.7513

Now refer to the 10% column of the extract from present value tables where you will see these factors in the tabulation.

If you are required to undertake such calculations without the assistance of discount tables, the formula set out above must be used.

Procedure

Since our DCF appraisal will be carried out before the beginning of a project, we shall have to reduce each of the net receipts/expenditures for future years to a present value. This is **discounting** the cash flow, which gives DCF its name, and it is usually done by means of tables, an extract of which you have already seen.

At the very start of a project the capital expenditure itself may be made, so that at that point there may be a substantial negative present value, since money has been paid out and nothing received. If all the present values of the years of the life of the investment (including the original cost) are added together, the result will be the **net present value**. This is known as the NPV and is a vital factor, because if it is positive it shows that the discounted receipts are greater than expenditures on the project, so that at that rate of interest the project is proving more remunerative than the stated interest rate.

The greater the NPV the greater the advantages of investing in the project rather than leaving the money at the stated rate of interest. But if the NPV is a minus quantity, it shows that the project is giving **less** return than would be obtained by investing the money at that rate of interest.

Example

A businessman is considering the purchase of a machine costing £1,000 which has a life of 3 years. He calculates that during each year it will provide a net receipt of £300; it will also have a final scrap value of £200. Instead, he could invest his £1,000 at 6%. Which course would be more advantageous?

First we must work out the cash flow.

	Receipts	**Payments**	**Net Receipt**
Year 0	Nil	£1,000	–£1,000
Year 1	£300	Nil	+£300
Year 2	£300	Nil	+£300
Year 3	£500	Nil	+£500

(Remember that the scrap value will count as a receipt at the end of the third year.)

But the businessman could be earning 6% interest instead; so this is the cost of his capital, and we must now discount these figures to find the present value:

	Net Receipt	**Discount Factor**	**Present Factor**
Year 0	–£1,000	1.0000	–£1,000.00
Year 1	+£300	0.9434	+£283.02
Year 2	+£300	0.8900	+£267.00
Year 3	+£500	0.8396	+£419.80
		Net present value:	– £30.18

As we have seen above, a negative NPV means that the investment is **not** profitable at that rate of interest. So the businessman would lose by putting his money into the machine. The best advice is for him to invest at 6%.

D. THE TWO BASIC DCF METHODS

You have now seen a simple example of how DCF is used, and you already have a basic knowledge of the principles which the technique employs. There are two different ways of using DCF – **the yield (or rate of return) method**, and **the net present value method**, which was used in the example above. The important point to remember is that both these methods give identical results. The difference between them is simply the way they are used in practice, as each provides an easier way of solving its own particular type of problem.

As we will see, the yield method involves a certain amount of trial-and-error calculation. Questions on either type are possible, and you must be able to distinguish between the methods and to decide which is called for in a particular set of circumstances.

In both types of calculation there is the same need for accurate information as to cash flow, which includes the initial cost of a project, its net income or outgoing for each year of its life, and the final scrap value of any machinery.

Yield (Internal Rate of Return) Method

This method is used to find the yield, or rate of return, on a particular investment. By yield we mean the percentage of profit per year of its life in relation to the capital employed. In other words, we must allow for **repayment of capital** before we consider income as being profit for this purpose. Obviously the profit may vary over the years of the life of a project, and so may the capital employed, so an **average** figure needs to be produced. DCF, by its very nature, takes all these factors into account.

The primary use of the method is to evaluate a particular investment possibility against a guideline for yield which has been laid down by the company concerned. For example, a company may rule that investment may be undertaken only if a 10% yield is obtainable. We then have to see whether the yield on the desired investment measures up to this criterion. In another case, a company may simply wish to know what rate of return is obtainable from a particular investment; thus, if a rate of 9% is obtainable, and the company's cost of capital is estimated at 7%, it is worth its while to undertake the investment.

What we are trying to find in assessing the figures for a project is the yield which its profits give in relation to its cost. We want to find the exact rate at which it would be breaking even, i.e. the rate at which discounted future cash flow will exactly equal the present cost, giving an NPV of 0. Thus if the rate of return is found to be 8%, this is the rate at which it is equally profitable to undertake the investment or not to undertake it; the NPV is 0. Having found this rate we know that if the cost of capital is above 8% the investment will be unprofitable, whereas if it is less than 8% the investment will show a profit. We thus reach the important conclusion that once we have assembled all the information about a project, the yield, or rate of return, will be the rate which, when used to discount future increments of income, will give an NPV of 0. We shall then know that we have found the correct yield.

Make sure you have followed why this will be the correct rate, and that you know exactly how and when to use the method, as practical questions are very much more likely than theoretical ones in the examination.

(a) When to Use the Yield Method

This is not a difficult problem, because you will use the method whenever you require to know the rate of return, or yield, which certain increments of income represent on capital employed. You must judge carefully from any DCF question whether this is what you need to know.

The yield method can be used to compare the internal rate of return with the cost of borrowing money from a bank.

(b) How to Use the Yield Method

The calculation is largely dependent on trial and error. When you use this method, you know already that you are trying to find the rate which, when used to discount the various increments of income, will give an NPV of 0. You can do this only by trying out a number of different rates until you hit on the correct result. A positive NPV means that the rate being tried is lower than the real rate; conversely, a negative NPV means that too high a rate is being used. So you need to work the problem out as many times as is necessary to hit on the appropriate rate for obtaining the NPV of 0. If this process is done sensibly, for simple problems such as those which we are going to encounter, it should not take many steps to hit upon the right result. Watch out for any instructions concerning rounding of yields – for example, to the nearest ½%.

(c) Examples of the Yield Method

Example 1

A company is considering investing in a three-year project that would cost £12,000 to commence. The annual returns would be £6,000, £4,000 and £2,000. At the end of the three years the machinery could be sold for £5,000. The company wishes to evaluate the internal yield in order to see what sorts of interest rate would be viable from the various sources known to the company.

The discount factor has to be assumed, so we shall start with 15%:

Year	Net Income/ Outgoing	Discount Factor	Discounted Present Value
0	–£12,000	1.0000	–£12,000
1	+6,000	0.8696	+£5,218
2	+£4,000	0.7561	+£3,024
3	+£7,000	0.6575	+£4,603
		Net present value:	+£845

A positive result, which means that the discount factor is too low, so try 20%:

Year	Net Income/ Outgoing	Discount Factor	Discounted Present Value
0	–£12,000	1.0000	–£12,000
1	+6,000	0.8333	+£5,000
2	+£4,000	0.6944	+£2,778
3	+£7,000	0.5787	+£4,051
		Net present value:	–£171

So the yield must come between the two values of 15% and 20%. Try 17%:

Year	Net Income/ Outgoing	Discount Factor	Discounted Present Value
0	–£12,000	1.0000	–£12,000
1	+6,000	0.8547	+£5,128
2	+£4,000	0.7305	+£2,922
3	+£7,000	0.6244	+£4,371
		Net present value:	+£421

Try 19%:

Year	Net Income/ Outgoing	Discount Factor	Discounted Present Value
0	–£12,000	1.0000	–£12,000
1	+6,000	0.8403	+£5,042
2	+£4,000	0.7062	+£2,825
3	+£7,000	0.5934	+£4,154
		Net present value:	+£21

So 19% is the yield. This means that it would be unwise to take out a loan that has an interest rate in excess of 19%. Similarly, a loan which is less than 19% interest will prove to be profitable under this project.

Example 2

A businessman is considering investment in a project with a life of 3 years, which will bring a net income in the first, second and third years of £800, £1,000 and £1,200 respectively. The initial cost is £2,500, and there will be no rebate from scrap values at the end of the period. He wishes to know, to the nearest 1%, the yield which this would represent. Using the present value tables, make the necessary calculation.

We must begin by choosing a possible rate and testing to see how near this is. Let's try 7%. Referring to the tables, we reach the following results.

Year	Net Income/ Outgoing	Discount Factor	Discounted Present Value
0	–£2,500	1.0000	–£2,500.00
1	+£800	0.9346	+£747.68
2	+£1,000	0.8734	+£873.40
3	+£1,200	0.8163	+£979.56
		Net present value:	+£100.64

A positive NPV, as we have seen, means that we have taken too low a rate for our attempt. Let's try 10% instead:

Year	Net Income/ Outgoing	Discount Factor	Discounted Present Value
0	–£2,500	1.0000	–£2,500.00
1	+£800	0.9091	+£727.28
2	+£1,000	0.8264	+£826.40
3	+£1,200	0.7513	+£901.56
		Net present value:	–£44.76

This time we have obtained a negative NPV so our rate of 10% must be too high. We now know that the rate must be between 7% and 10%. Only a proper calculation can give us the true answer, but having obtained a positive NPV for 7% and a negative NPV for 10% we can ascertain the approximate rate by interpolation using the formula:

$$\text{Rate} = X + \frac{a}{a+b}(Y - X)$$

where: X = Lower rate of interest used

Y = Higher rate of interest used

a = Difference between present values of the outflow and the inflow at X%

b = Difference between present values of the outflow and the inflow at Y%

Inserting the rates of 7% and 10% into this formula, we get:

$$\text{Rate} = 7 + \frac{101}{101 + 45}(10 - 7)$$

$$= 7 + 2 = 9\% \text{ (approx.)}$$

So we shall try 9%.

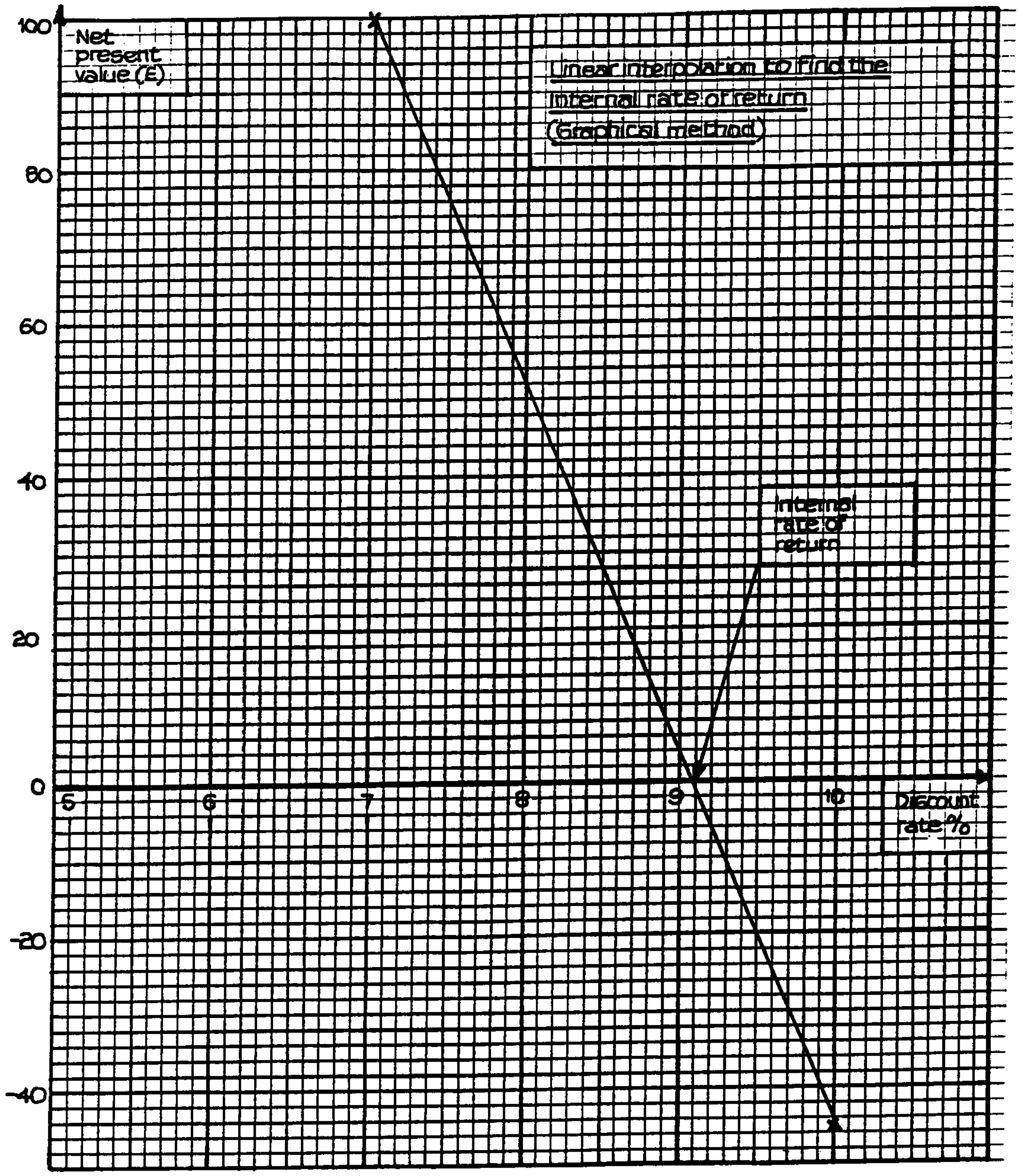
Year	Net Income/ Outgoing	Discount Factor	Discounted Present Value
0	–£2,500	1.0000	–£2,500.00
1	+£800	0.9174	+£733.92
2	+£1,000	0.8417	+£841.70
3	+£1,200	0.7722	+£926.64
		Net present value:	+£2.26

Clearly since we are working to the nearest 1% we are not going to get any closer than this. However, if you have time available there is no reason why you should not work out the next nearest rate (in this case, 8%) just to check that you already have the nearest one.

So the yield from this investment would be 9%.

Note

The interpolation may be performed graphically rather than by calculation, as shown in the following graph. The discount rate is on the horizontal axis and the net present value on the vertical axis. For each of the two discount rates, 7% and 10%, we plot the corresponding net present value. We join the two points with a ruled line. The net present value is zero where this line crosses the horizontal axis. The discount rate at this point is the required internal rate of return. We see that the rate is 9%, correct to the nearest 1%, and this confirms the result of the calculation.



Net Present Value (NPV) Method

The NPV method is probably more widely used than the yield method, and its particular value is in comparing two or more possible investments between which a choice must be made. If a company insists on a minimum yield from investments of, say, 10%, we could check each potential project by the yield method to find out whether it measures up to this. But if there are several projects each of which yields above this figure, we still have to find some way of choosing between them if we cannot afford to undertake all of them.

At first sight the obvious choice would be that which offered the highest yield. Unfortunately this would not necessarily be the best choice, because a project with a lower yield might have a much longer life, and so might yield greater profit.

However, we can solve the problem in practice by comparing the net present values of projects instead of their yields. The higher the NPV of a project or group of projects, the greater is its value and the profits it will bring.

We must remember that in some instances the cost of capital will be higher for one project than for another. For example, a company which manufactures goods may well be able to borrow more cheaply for its normal trade than it could if it decided to take part in some more speculative process. So each project may need to be assessed at a different rate in accordance with its cost of capital. This does not present any particular problems for DCF.

(a) NPV Method and Yield Method Contrasted

You should now be able to see the important difference between the NPV method and the yield method. In the yield method we were trying to find the yield of a project by discovering the rate at which future income must be discounted to obtain a fixed NPV of 0. In the NPV method we already know the discounting rate for each project (it will be the same as the cost of capital) and the factor which we are now trying to find for each project is its NPV. The project with the highest NPV will be the most profitable in the long run, even though its yield may be lower than other projects.

So you can see that comparison of projects by NPV may give a different result from comparison by yields. You must decide for each particular problem which method is appropriate for it.

(b) How to Use the NPV Method

You must first assemble the cash flow figures for each project. Then carry out the discounting process on each annual net figure at the appropriate rate for that project, and calculate and compare the NPVs of the projects. As we have seen, that with the highest NPV will be the most profitable.

(c) Example of the NPV Method

An earlier example was based on the NPV method, but the following one shows use of the method to **compare** two projects.

Example

The ABC Engineering Co. are trying to decide which of the two available types of machine tool to buy. Type A costs £10,000 and the net annual income from the first 3 years of its life will be £3,000, £4,000 and £5,000 respectively. At the end of this period it will be worthless except for scrap value of £1,000. To buy a Type A tool, the company would need to borrow from a finance group at 9%. Type B will last for three years too, but will give a constant net annual cash inflow of £3,000. It
costs £6,000 but credit can be obtained from its manufacturer at 6% interest. It has no ultimate scrap value. Which investment would be the more profitable?

Type A

Year	Net Cash Income	Discount Factor *9%*	Discounted Present Value
0	–£10,000	1.0000	–£10,000.00
1	+£3,000	0.9174	+£2,752.20
2	+£4,000	0.8417	+£3,366.80
3	+£5,000 +£1,000	0.7722	+£4,633.20
		Net present value:	+£752.20

Type B

Year	Net Cash Income	Discount Factor *6%*	Discounted Present Value
0	–£6,000	1.0000	–£6,000.00
1	+£3,000	0.9434	+£2,830.20
2	+£3,000	0.8900	+£2,670.00
3	+£3,000	0.8396	+£2,518.80
		Net present value:	+£2,019.00

Thus we can see that Type B has a far higher NPV and this will be the better investment. (Note carefully how the different costs of capital affect the result. You must always watch out for similar complications if they should arise in problems.)

APPENDIX: PRESENT VALUES TABLES

These tables give the present values of £1 at different rates of interest (to four significant figures).

Table 1

Year \ Rate	2%	3%	4%	5%	6%	7%
1	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346
2	0.9612	0.9426	0.9246	0.9070	0.8900	0.8734
3	0.9423	0.9151	0.8890	0.8638	0.8396	0.8163
4	0.9238	0.8885	0.8548	0.8227	0.7921	0.7629
5	0.9057	0.8626	0.8219	0.7835	0.7473	0.7130
6	0.8880	0.8375	0.7903	0.7462	0.7050	0.6663
7	0.8706	0.8131	0.7599	0.7107	0.6651	0.6227
8	0.8535	0.7894	0.7307	0.6768	0.6274	0.5820
9	0.8368	0.7664	0.7026	0.6446	0.5919	0.5439
10	0.8203	0.7441	0.6756	0.6139	0.5584	0.5083
11	0.8043	0.7224	0.6496	0.5847	0.5268	0.4751
12	0.7885	0.7014	0.6246	0.5568	0.4970	0.4440
13	0.7730	0.6810	0.6006	0.5303	0.4688	0.4150
14	0.7579	0.6611	0.5775	0.5051	0.4473	0.3878
15	0.7430	0.6419	0.5553	0.4810	0.4173	0.3624
16	0.7284	0.6232	0.5339	0.4581	0.3936	0.3387
17	0.7142	0.6050	0.5134	0.4363	0.3714	0.3166
18	0.7002	0.5874	0.4936	0.4155	0.3503	0.2959

Table 2

Year \ Rate	8%	9%	10%	11%	12%	13%
1	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850
2	0.8573	0.8417	0.8264	0.8116	0.7972	0.7831
3	0.7938	0.7722	0.7513	0.7312	0.7118	0.6931
4	0.7350	0.7084	0.6830	0.6587	0.6355	0.6133
5	0.6806	0.6499	0.6209	0.5935	0.5674	0.5428
6	0.6302	0.5963	0.5645	0.5346	0.5066	0.4803
7	0.5835	0.5470	0.5132	0.4817	0.4523	0.4251
8	0.5403	0.5019	0.4665	0.4339	0.4039	0.3762
9	0.5002	0.4604	0.4241	0.3909	0.3606	0.3329
10	0.4632	0.4224	0.3855	0.3522	0.3220	0.2946
11	0.4289	0.3875	0.3505	0.3173	0.2875	0.2607
12	0.3971	0.3555	0.3186	0.2858	0.2567	0.2307
13	0.3677	0.3262	0.2897	0.2575	0.2292	0.2042
14	0.3405	0.2992	0.2633	0.2320	0.2046	0.1807
15	0.3152	0.2745	0.2394	0.2090	0.1827	0.1599
16	0.2919	0.2519	0.2176	0.1883	0.1631	0.1415
17	0.2703	0.2311	0.1978	0.1696	0.1456	0.1252
18	0.2502	0.2120	0.1799	0.1528	0.1300	0.1108

Table 3

Year \ Rate	14%	15%	16%	17%	18%	19%
1	0.8772	0.8696	0.8621	0.8547	0.8475	0.8403
2	0.7695	0.7561	0.7432	0.7305	0.7182	0.7062
3	0.6750	0.6575	0.6407	0.6244	0.6086	0.5934
4	0.5921	0.5718	0.5523	0.5337	0.5158	0.4987
5	0.5194	0.4972	0.4761	0.4561	0.4371	0.4190
6	0.4556	0.4323	0.4104	0.3898	0.3704	0.3521
7	0.3996	0.3759	0.3538	0.3332	0.3139	0.2959
8	0.3506	0.3269	0.3050	0.2848	0.2660	0.2487
9	0.3075	0.2843	0.2630	0.2434	0.2255	0.2090
10	0.2697	0.2472	0.2267	0.2080	0.1911	0.1756
11	0.2366	0.2149	0.1954	0.1778	0.1619	0.1476
12	0.2076	0.1869	0.1685	0.1520	0.1372	0.1240
13	0.1821	0.1625	0.1452	0.1299	0.1163	0.1042
14	0.1597	0.1413	0.1252	0.1110	0.09855	0.08757
15	0.1401	0.1229	0.1079	0.09489	0.08352	0.07359
16	0.1229	0.1069	0.09304	0.08110	0.07078	0.06184
17	0.1078	0.09293	0.08021	0.06932	0.05998	0.05196
18	0.09456	0.08081	0.06914	0.05925	0.05083	0.04367

Table 4

Year \ Rate	20%	21%	22%	23%	24%	25%
1	0.8333	0.8264	0.8197	0.8130	0.8065	0.8000
2	0.6944	0.6830	0.6719	0.6610	0.6504	0.6400
3	0.5787	0.5645	0.5507	0.5374	0.5245	0.5120
4	0.4823	0.4665	0.4514	0.4369	0.4230	0.4096
5	0.4019	0.3855	0.3700	0.3552	0.3411	0.3277
6	0.3349	0.3186	0.3033	0.2888	0.2751	0.2621
7	0.2791	0.2633	0.2486	0.2348	0.2218	0.2097
8	0.2326	0.2176	0.2038	0.1909	0.1789	0.1678
9	0.1938	0.1799	0.1670	0.1552	0.1443	0.1342
10	0.1615	0.1486	0.1369	0.1262	0.1164	0.1074
11	0.1346	0.1228	0.1122	0.1026	0.09383	0.08590
12	0.1122	0.1015	0.09198	0.08339	0.07567	0.06872
13	0.09346	0.08391	0.07539	0.06780	0.06103	0.05498
14	0.07789	0.06934	0.06180	0.05512	0.04921	0.04398
15	0.06491	0.05731	0.05065	0.04481	0.03969	0.03518
16	0.05409	0.04736	0.04152	0.03643	0.03201	0.02815
17	0.04507	0.03914	0.03403	0.02962	0.02581	0.02252
18	0.03756	0.03235	0.02789	0.02408	0.02082	0.01801

Study Unit 19

Presentation of Management Information

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INTRODUCTION

The purpose of this last study unit is to provide you with guidance on how to present the information you will have gathered in the course to date. No matter how much knowledge you possess on a topic, if you cannot impart the information concisely and succinctly then much of its impact can be lost. We shall, therefore, examine different aspects of presentation such as report writing, the use of diagrams and charts and tailoring the information to the needs of the user.

A. GENERAL PRINCIPLES OF PRESENTATION

Information for Decision Making

Management accounting data is produced for the purpose of planning, control and decision making and these factors must be borne in mind in the preparation and presentation of information. Different levels of management will require different types of information, according to their status and responsibilities. The general principles which should be followed in the presentation of information are as follows:

- Data and reports should be produced **as soon as possible after the event**.
- Reports should be as **accurate** as possible.
- The requirements of the **individual manager** must be provided for.

Timing and Accuracy

Speed of presentation is crucial in the process of control and decision making. Information which is entirely accurate and produced a long time after the event may be of little or no use to the manager, whereas information which is approximately correct and produced quickly can be used effectively.

B. MANAGEMENT INFORMATION

Reports and Analyses

Reports and analyses can take a number of different forms but, in most organisations, regular, periodic reports will be produced on standard forms. Routine and special reports may be illustrated or supplemented by charts, graphs and statistics, **provided that the receiver is not confused by too much detail**.

User Requirements

The amount of detail provided will depend upon the **level of management** for which the information is supplied.

At the highest level, such as the managing director or the general manager, the reports will be broadly based and designed to give an **overall picture** of the organisation. These reports will be designed to enable the executive to monitor the progress of **all** activities, and they will be as free from detail as possible.

At lower levels, more details will be required, but **restricted to the function or activity being covered**. At the lowest level, just **one cost centre or activity** may be involved, such as for a superintendent of a machine group.

Information to be Supplied

(a) Managing Director

- ***Budget Reports***

  Monthly reports, showing the actual and budgeted results, with variances showing where corrective action is required.

- ***Financial Accounts***

  Monthly profit and loss accounts and balance sheets.

- ***Sales Reports***

  Weekly/monthly reports, showing budgeted and actual sales by product, territory, customer or other required analysis. This may also include details of orders received under similar headings.

- ***Factory Reports***

  Output: daily/weekly figures.

  Stocks: details of stockholdings under major headings of raw materials, work-in-progress and finished goods.

- ***Cash Flow***

  Weekly/monthly cash flow statements on a rolling budget basis.

- ***Capital Expenditure***

  Budgeted and actual capital expenditure, with details of under- or over-spending and projections of future capital expenditure.

- ***Special Analyses***

  Reports on new projects or special situations, as necessary.

(b) Sales Director

- ***Budget Reports***

  Sales in money value and units, analysed by product, territory, salesperson, as required, with actual and budget comparisons.

  Cost figures for the sales function, with budget and actual comparisons.

- ***Bad Debts***

  Source of bad and doubtful debts, and salespeople involved.

- ***Orders Received***

  Weekly/monthly analyses.

- ***Stocks***

  Stock levels of finished goods.

- ***Special Reports***

  Analysis for pricing decisions, advertising campaigns, launch of new products.

(c) Production Director

- ***Budget Reports***

  Actual and budget cost comparisons by cost centres.

- ***Efficiency Reports***

  Standard and actual comparisons for materials, labour and overheads, with additional analyses for variances which require further investigation.

- ***Stock Reports***

  Raw materials, work-in-progress, finished goods.

- ***Capital Expenditure***

  Planned and actual expenditure.

  Schedules for delivery and installation of new equipment.

- ***Machine Use***

  Percentages of capacity employed and analysis of causes of lost or idle time.

- ***Maintenance***

  Cost of maintenance, with actual and budget comparisons.

- ***Service Costs***

  Factory, services and supplies.

  Costs for stores, internal transport and other factory services.

- ***Other Reports***

  These will usually be related to proposals concerning new equipment, working arrangements, bonus schemes or changes in methods, and particularly the costing aspects of such changes.

(d) Other Executives

Depending on the nature of the company concerned, other managers should receive reports on similar lines to those supplied to the managers mentioned above. The general aim will be to show budgeted and actual expenditure and controllable variances.

Effectiveness of Management Information Systems

Periodic reviews of management information systems should be carried out to test the suitability and effectiveness of the system. The objects of such a review should be:

- To assess the **suitability** of the information supplied and the **degree of accuracy** required by the manager.
- To find the use to which information is put, and whether it is the right type of information for the purposes for which it is required.
- To see the speed with which the information is produced, and if it is presented in time and in the most effective manner.
- To consider the cost of providing information and the benefits obtained.

Report Writing

The communication of information in the form of reports is an important aspect in the study of management accounting. Reports are required in practical business situations for many different purposes, and examination questions often simulate a practical problem, requiring an answer in report format. The general principles of report writing are relatively simple but they require careful observance:

- **Title**

  This should be as short as possible but it must convey clearly the **subject** of the report.

- **Date**

  This should not be overlooked, as it may be very relevant when **subsequent developments** are being considered.

- **Addressee(s)**

  The name(s) of the **receiver(s)** of the report should be shown, together with the name of the **writer** of the report. (For examination question answers you should **not** use your own name.)

- **Introduction**

  A short introduction may be required, indicating the **reason** or **brief** for preparing the report.

- Body of the Report

  This will contain the main substance of the report, with reference to **facts, conclusions** and **recommendations**.

- **Appendices**

  To avoid overloading the main content and conclusions, it may be necessary to append charts, graphs and statistical tables as numbered appendices, making the main section of the report easier to read.

- Style

  Try to adopt a **logical sequence** in the report, with section and subsection headings as necessary.

Diagrams and Charts

Trends and major features of statistical data can often be more easily appreciated by the use of diagrams and charts. Comparisons can be made on a single chart but **trends**, rather than actual figures, will be shown.

Care must be taken not to make charts too complicated, as over-elaboration will confuse, rather than highlight the significant points in the data.

(a) Line Graphs

The characteristic of line graphs, or **histograms**, is that the vertical axis is the **unit** of the subject being observed. The horizontal axis represents the **time** factor – hours, day, months, years (see Figure 19.1).

Monthly Sales: January to June

Month	£
Jan	9,000
Feb	9,500
Mar	8,700
Apr	9,200
May	9,400
Jun	9,700

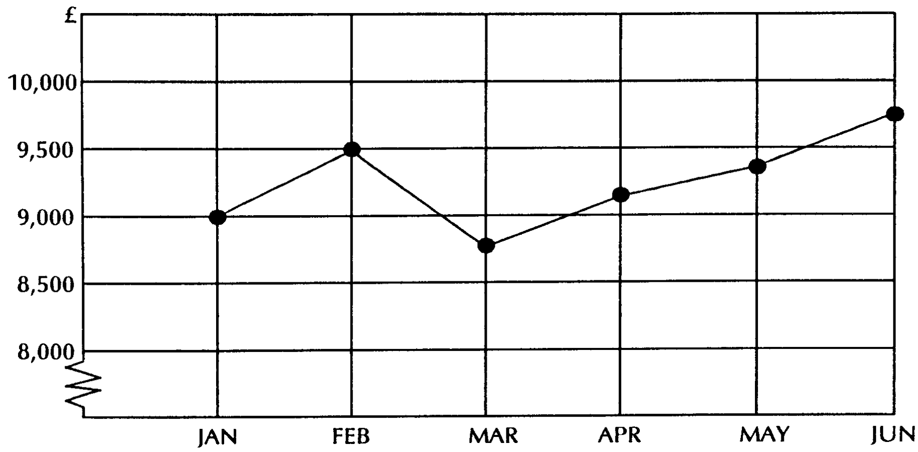

Figure 19.1: Histogram of Monthly Sales Data

As an alternative to plotting actual number values, the **logarithms** of these numbers may be used. These will be helpful in judging the **relative** rate of increase or decrease in the numbers observed.

(b) Z Charts

These charts, called Z charts because of the outline shape of the graph, combine three curves:

- The curve of the original data
- The cumulative total of the original data
- The moving average total of the data.

The chart is particularly suited to showing **sales curves**, as in Figure 19.2.

Monthly Sales: January to June

Month	Monthly Sales £	Cumulative Sales £	Six-Months Moving Average Total £
Jan	1,200	1,200	6,800
Feb	900	2,100	7,000
Mar	1,100	3,200	7,100
Apr	1,300	4,500	7,300
May	1,000	5,500	7,000
Jun	1,100	6,600	6,600

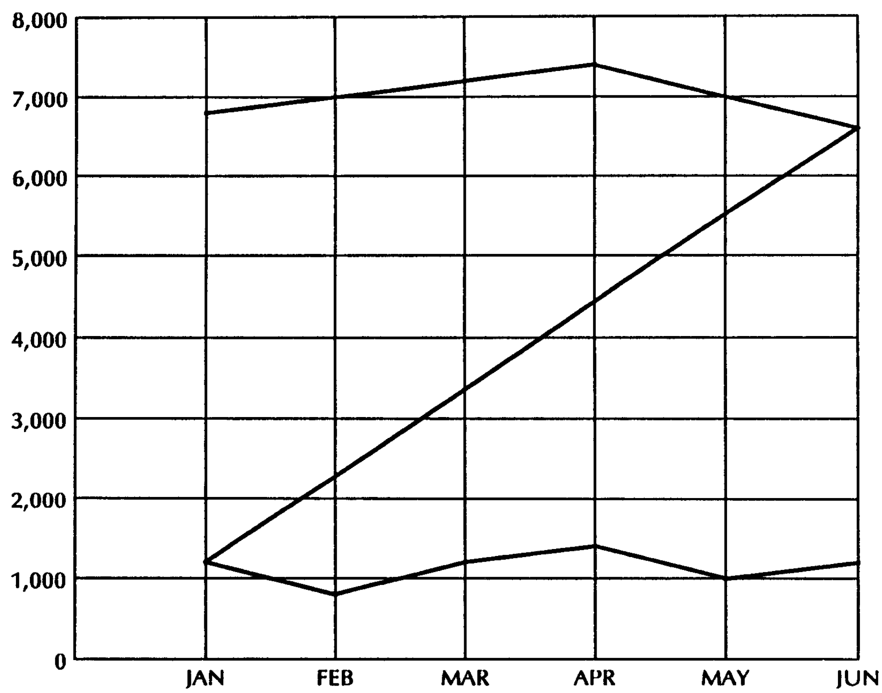

Figure 19.2: Z Chart of Monthly Sales Data

(c) Bar Charts

This type of chart uses varying lengths of bar to show values of units, and it is widely used for **making comparisons**. Simple bar charts use a single bar to represent each item. In component or compound bar charts, the bars are divided into segments to show sub-totals or a breakdown into categories.

Figure 19.3 is a bar chart of the following wages data:

Wages

		Factory £000	Admin. £000	Total £000
Yr. 0:	Quarter 1	40	10	50
	2	38	11	49
	3	42	12	54
	4	45	12	57
		165	45	210
Yr. 1:	Quarter 1	46	13	59
	2	45	13	58
	3	47	14	61
	4	49	15	64
		187	55	242

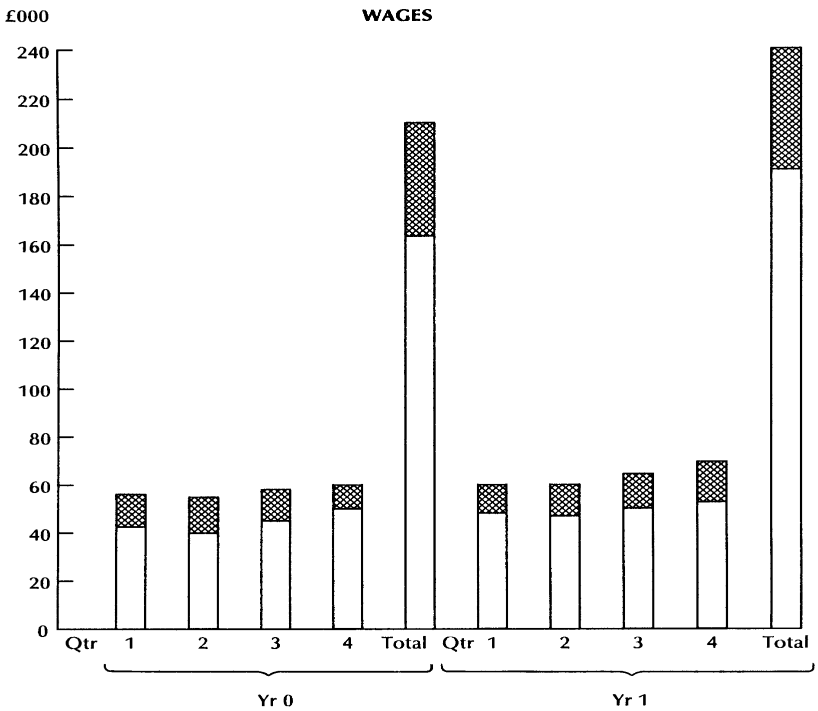

Figure 19.3: Bar Chart of Wages Data

(d) Pie (or Circle) Charts

The pie chart is so called because it is based on a circle divided into segments, or slices, in order to show the **relationship of the various portions to the whole**. It is commonly used to show division of a company's costs and profits, as in Figure 19.4.

Pie charts suffer from the fact that it is difficult to show actual relationships from one period to another, and the sizes of different circles can sometimes lead to incorrect interpretation. While pie charts make an immediate impression, their usefulness is limited.

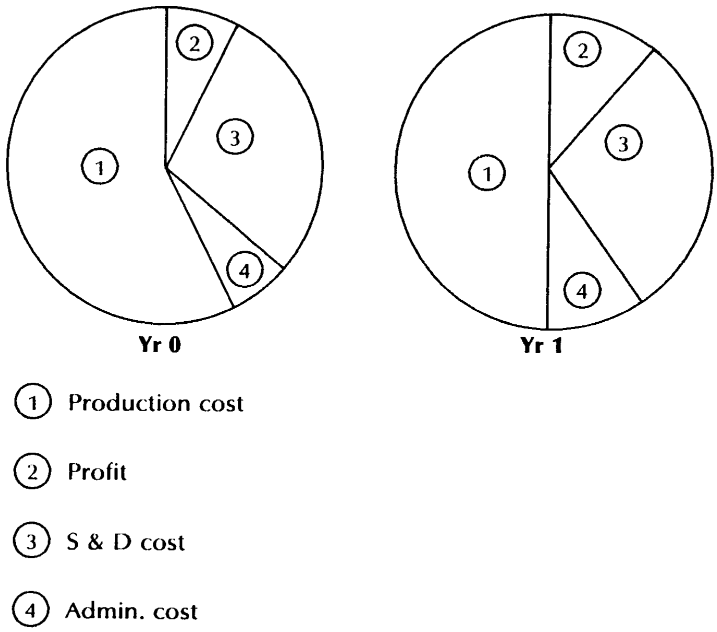

Figure 19.4: Pie Charts of Company Costs and Profits

They are based on calculations related to the degrees in a circle totalling 360°. Hence for Yr. 1, say, the total of profit and costs had been as follows:

	£	
Production cost	100,000	$360° \times \frac{100}{200} = 180°$
Profit	25,000	$360° \times \frac{25}{200} = 45°$
Selling and Distribution cost (S & D)	55,000	$360° \times \frac{55}{200} = 99°$
Admin. cost	20,000	$360° \times \frac{20}{200} = 36°$
Total	200,000	

The appropriate segments are shown in the pie chart.